The Journal
OF THE
Royal United Service Institution.

VOL. XVIII. 1874. No. LXXVI.

Evening Meeting.

Monday, January 19th, 1874.

VICE-ADMIRAL SIR JOHN C. DALRYMPLE HAY, Bart., C.B., M.P., F.R.S., &c., Vice-Chairman of the Council, in the Chair.

NAMES OF MEMBERS who joined the Institution between the 1st and 19th of January, 1874.

LIFE.

Heathcote, F. A., Lieut. 81st Regiment.

ANNUAL.

Welsh, D. J., Major R.A.
Glyn, R. T., Colonel 24th Regiment.
Tongue, J. M. Gunel, Captain 24th Regt.
Dickinson, J. D., Lieut. 24th Regiment.
Courtenay, E. J., Lieut. 35th Regiment.
Mostyn, W. E., Captain 24th Regiment.
Carrington, Frederick, Lieut. 24th Regt.
Melvill, Trign., Lieut. 24th Regiment.
Browne, E. S., Lieut. 24th Regiment.
Curteis, E. W., Lieut. 24th Regiment.
Haughton, John, Lieut. 24th Regt.
Cavaye, C. W., Lieut. 24th Regiment.
Perry, Lionel F., Lieut. R.A.
Simkins, J. G., Lieutenant 2nd Middlesex Militia.
Webb, W. F., Lieut., late 17th Lancers.
Pocklington, E. B., Lieut. 52nd Regt.
Godsal, P. T., Lieut. 52nd Regiment.
Glendonwyn, W. R. D. S., Lieutenant 69th Regiment.
Owen, R. E., Lieut. 69th Regiment.
Borton, A. J., Captain 69th Regiment.
Ingram, E. R. B., Lieut. 69th Regt.
Banfield, R. J. F., Lieut. 69th Regt.
Ryley, Frank, Lieut. 81st Regiment.
Moody, J. L., M.A., Chaplain to the Forces.
Parsons, Clifford, Major 3rd Buffs.
Curzon, Hon. Montagu, Lieutenant Rifle Brigade.
McMullin, J., Captain, Madras Staff Corps.
Chichester, Francis S., Lieutenant, late 22nd Regiment.
Needham, John L., Lieut. R.M.A.
Rolls, H. J., Lieutenant 3rd Middlesex Artillery Volunteers.
James, E., Major, late Rifle Brigade.
Prickett, Thomas, Lieut. 56th Regt.
Bacon, C. B. G., Colonel Bengal Staff Corps.
Templeton, J. M., Major Victoria R. V. Force.
Collings, G. M., Captain R.E.
Preston, Arthur T., Lieutenant R.E.
Reid, P. Savill G., Lieutenant R.E.
Lethbridge, Sir Wroth A., Bart., late Lieut. Rifle Brigade.

ECONOMY OF COAL AS VIEWED BY THE COMMANDER OF A STEAM VESSEL.

By P. Frederick Shortland, Captain, R.N., LL.D., late Fellow of Pembroke College, Cambridge, and Barrister-at-Law.

In discussing the question of economy in the expenditure of coal as it presents itself to the Officer in command of a steam-vessel, we must always remember that the form of the vessel, the construction of her boilers, and the nature of her engines, are entirely beyond his control; the utmost he can do is to use them so as to produce the best possible results, therefore the principles upon which the economy we are about to investigate rests, must be common to all steamers.

From this point of view two elements demand particular attention, the value of the coal on board the vessel, and that of the vessel's time during her voyage; the proportion which these bear to each other must be carefully considered and clearly estimated.

The value of the coal after it is stowed on board the vessel, will generally differ considerably from the cost of the coal, including the expense of placing it on board; it will vary with the facilities of coaling, and the price of coal at the different ports of call during the voyage she is about to make, as compared with those at her port of departure; the capacity of the vessel for carrying coal as compared with her daily consumption and the length of her voyage; and many other circumstances will arise to affect the value of coal which will be readily understood from those just mentioned; all must be carefully considered and compared by the Commander of a steamer, and the value of the coal on board during the voyage he is about to make estimated as accurately as possible.

A correct appreciation of the value of the ship's time during the voyage is essentially necessary, and the difficulty of arriving at a good practical conclusion on this point will vary with the employment of the vessel, being much easier for merchantmen than for vessels of war. In the former case, the running expenses of the vessel and the importance of reaching her port of destination, will give the value of her time; but vessels of war are kept for the protection of the country, as well as for the special services they may be employed upon, and therefore a very large portion of their expenses must be set down to that service, and only those special circumstances which render the vessel more valuable at her port of destination than at her port of departure, should be taken into account; these being all known to the authority ordering the service, the value of the vessel's time during the voyage should be stated in her sailing orders. I think this has not been overlooked of late years. I remember, whilst under the command of Lord Clarence Paget in the Mediterranean, he divided the sailing orders into three classes according to the importance of the service, and thus regulated the expenditure of coal during the voyage. It is obvious that if the vessel's time is of no value, consuming coal to increase her speed would be mere waste; therefore when we are considering the economical use

of coal for this purpose, the value of the vessel's time, independently of the consumption of any coal, must be clearly understood, and the more accurately its value can be estimated, the more accurate will be our determination of the quantity of coal to be consumed in order to produce the most economical result.

We shall suppose, therefore, that the value of the vessel's time, and that of the coal on board, have been determined, and that the value of one hour of the ship's time when not under steam is equal to that of a certain number of hundredweights of coal, which we will denote by the symbol S.

Confining our attention for the present to the conditions under which a given quantity of coal will propel the vessel farthest, we remark two things, both of great importance, but essentially different—

1. The boilers in which the steam is generated.
2. The engines in which the steam is used; and that these should be examined separately.

The economical use of the boilers depends upon the number employed with reference to the quantity of steam required. It is well known that when the fires are urged to the utmost in order to make a boiler generate the largest possible quantity of steam in a given time, a pound of coal will evaporate less water than when, with lighter fires, the boiler is evaporating a smaller quantity of water in the same time, and this improvement continues until the water evaporated in the given time has been reduced to a certain quantity, when the boiler will have reached its condition of most economical evaporation, because if the fires are farther reduced, and a less quantity of water evaporated in the given time, a pound of coal will now evaporate less water than it did before, and both reductions will go on together.

Her Majesty's Ship "Hydra" had two boilers which each consumed about 10 cwt. of coal per hour when doing their utmost, and 4 cwt. each per hour when doing their best.

One boiler, when used separately and consuming 7 cwt. of coal per hour, could generally supply sufficient steam for the engines when on the fifth grade of expansion.

Two boilers when used together under similar circumstances, did the same duty when each consumed 3 cwt. of coal per hour, so that by using, under these circumstances, two boilers instead of one, the consumption of coal was reduced to the extent of 1 cwt. per hour.

Each boiler consumed about 10 cwt. of coal to get up steam, and therefore when the steam was required to supply the fifth grade for any period exceeding ten hours, it was better to light the fires in both boilers in preference to one. I may here remark that when steaming on the fifth grade of expansion, we could, by consuming 4 cwt. of coal per hour in each boiler, bring them to their best condition, and by condensing the surplus steam, fill the water-tanks in the most economical manner.

We have no good means of comparing directly with each other the different conditions of the boiler, because the only method generally applicable of estimating the quantity of water evaporated by the boiler

in a given time, is by calculating the quantity of water supplied by the feed-pumps; but we can with greater accuracy compare with each other the quantities of steam supplied to the cylinder by the boiler, when in different states of production corresponding to the consumption of different quantities of coal, and from these comparisons we can find the quantity of coal a boiler consumes in a given time, when a given quantity of steam is supplied to the cylinder by the consumption of the least possible quantity of coal; for the sake of distinction, this state of the boiler may be termed its condition of greatest economy, remarking that we must carefully distinguish it from the boiler's condition of most economical evaporation, from which it differs in consequence of the portion of the steam generated in the boiler which is lost whilst passing to the cylinder and there finishing its duty.

We will now show how to find approximately, but with sufficient accuracy for practical purposes, the quantity of coal which a boiler will consume when in its condition of greatest economy. By examining the steam returns of the vessel, or from actual observation, find the final pressure of the steam in the cylinder, the number of revolutions made by the engine, and the quantity of coal consumed in a given time by the boiler when in three different conditions of evaporation.

First, when generating a small quantity of steam.

Secondly, when generating a moderate quantity.

Thirdly, when generating a large quantity.

The quantity of steam used in the cylinder in a given time is proportional to the final pressure of the steam in the cylinder multiplied by the number of revolutions made by the engines; the temperature of the steam being the same, and the more economically this steam is supplied, the larger will be the quantity of useful steam in proportion to the coal consumed to produce it. We may, therefore, take the quotient derived from the division of the useful steam by its coal as a measure of the economical condition of the boiler, the larger the number expressing this quotient, the greater will be the economy, and when we have found the largest possible quotient, the corresponding quantity of coal will be that which will give the boiler its condition of greatest economy.

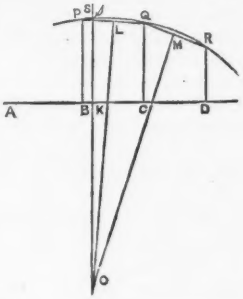
The quantities obtained in the manner before described, will give three different quotients, which we shall in future call economical quotients.

Take a pencil, a pair of compasses, a common scale of equal parts, and a sheet of paper, upon which draw the straight line ABCD.

From A lay off AB, AC and AD each equal in length to number of equal parts on the scale corresponding to the respective quantities of coal consumed; from the points B, C, and D thus determined, draw BP, CQ, and DR each perpendicular to ABCD, and make BP equal in length to the number of equal parts corresponding to the economical quotient resulting from the division of the useful steam by the coal represented by AB, CQ equal to that corresponding to the coal represented by AC and DR to that corresponding to the coal represented by AD.

Join PQ and QR by straight lines which bisect in the points L and

M respectively by the perpendiculars LO and MO meeting each other in the point O, from which draw OKS perpendicular to ABCD,



and intersecting it in K; then AK will represent approximately the quantity of coal the boiler will consume when in its condition of greatest economy.

It will be perceived from the construction that O is the centre of the circle passing through the points P, Q, and R, let this circle be described and cut KS in *s*, then K*s* will be the longest ordinate of the circle PQR. It is evident that the extremities of all the ordinates representing the economical quotients will lay in some curve, and the nearer the circle PQR agrees with this curve, the nearer K*s* will approach the largest economical quotient we are seeking, to ascertain if this difference is of practical importance, consume in the boiler the quantity of coal represented by AK, and find its economical quotient; let this be KS, if the point S lays near *s*, or agrees with it, we need not proceed farther, otherwise by describing the circle through the points P, S, and Q we shall obtain a new value of AK, which will be a nearer approximation to the quantity of coal we are endeavouring to discover. It will not generally be necessary to proceed beyond the first step in the process we have described, because when an effect is near its maximum, a large variation in the cause produces only a small or insensible variation in the effect, consequently an error in the position of the point K will produce a very small or insensible one in the economical quotient, so that generally the first value obtained for AK will be sufficient for practical purposes, besides, though theoretically considered, observations so taken that P, Q, and R may be near each other, will give a better approximation to the curve in which they are situated; yet the many extraneous causes which disturb the condition of a boiler, as well as the size of the errors the observations are liable to, upon which we are obliged to rely, introduce errors which are larger than the variations due to the changes in the magnitude of the cause unless these be of a considerable size; practically, therefore, we shall obtain a better result when the points P, Q, and R are at a distance from each other, than when they possess the theoretical advantage of being near together.

In order to give a practical illustration of the foregoing, I have, with their Lordships' permission, taken the following from a steam report of Her Majesty's Ship "Swiftsure," the object of which being different from that we have in view, we do not, as we might naturally expect, find in it exactly what we want, the final pressure of the steam in the cylinder, so very valuable for pointing out the conditions of economy we are discussing, is not noted in the return; fortunately, the indicator diagrams sent with it, afforded the means of determining the final pressures sufficiently well for an illustration. The final pressures noted in the table were kindly taken off the diagrams by Mr. Sennett, a very intelligent gentleman in the Steam Department of the Admiralty.

The quantities given below are the means derived from trials, each made during eight hours under favourable circumstances of weather—

Number of boilers and furnaces used.	Number of revolutions of the engines per minute.	Final pressure of steam in cylinder. Pounds per square inch.	Coal consumed per hour.	Description of coal used.
4 boilers, 20 furnaces .	52·3	7·3	47·295	½ Welsh, ½ North Country.
3 boilers, 12 furnaces .	41·06	5·0	25·43	Ditto ditto.
2 boilers, 10 furnaces .	31·37	4·5	13·473	Ditto ditto.
Ditto ditto.....	28·25	4·0	7·466	Welsh.
Ditto ditto.....	29·49	4·75	17·355	⅓ Welsh, ⅔ North Country, generally bad.
Mean of two last	28·87	4·375	12·41	⅔ Welsh, ⅓ North Country.

In the two last observations made with two boilers and ten furnaces, there is a remarkable difference in the consumption of coal, which cannot be entirely due to the difference in the quality and description of the coal used, the framers of the report rejected the latter from their comparison; but I have taken the mean of the two because it brings into comparison more nearly the same description of coal.

To calculate the economical quotients which in future will be denoted by E Q, we have—

4 boilers, 20 furnaces, consuming 47·295 cwt..... $\left.\right\}$ $EQ = \frac{52{\cdot}3 \times 7{\cdot}3}{47{\cdot}295} = 8{\cdot}0725$

3 boilers, 12 furnaces, consuming 25·43 cwt. .... $\left.\right\}$ $EQ = \frac{41{\cdot}06 \times 5}{25{\cdot}43} = 8{\cdot}0735$

2 boilers, 10 furnaces, consuming 13·47 cwt. .... $\left.\right\}$ $EQ = \frac{31{\cdot}37 \times 4{\cdot}5}{13{\cdot}47} = 10{\cdot}48$

2 boilers, 10 furnaces, consuming 12·41 cwt. .... $\left.\right\}$ $EQ = \frac{28{\cdot}87 \times 4{\cdot}375}{12{\cdot}41} = 10{\cdot}177$

The comparison of the economical quotients shows that the economical conditions of the boilers in the two first trials were so nearly the same, that their comparison will not help us to discover that which we are seeking; however, the third gives a much larger economical quotient than either, and will, with the first, answer our purpose very well; but in order to compare them, we must make an assumption which, as will be explained hereafter, is not strictly accurate, but sufficiently so to serve the purpose of an illustration.

We therefore assume that two boilers with ten furnaces consuming 23·6475 cwt. of coal per hour, will have the same economical quotient as four boilers with twenty furnaces burning 47·295 cwt. of coal in the same time.

Referring to the figure in page 9—

Make AB = 12·41	BP = 10·177
„ AC = 13·47	CQ = 10·48
„ AD = 23·6475	DR = 8·072

which gives AK = 15·8 cwt.

In this example, P and Q are too close to give a good value to AK, therefore if it had been in our power, the best plan would have been to have tried two boilers with ten furnaces, when consuming from 6 cwt. to 7 cwt. per hour, to have found the corresponding economical quotient, and to have used the values of AB and BP thus obtained in preference.

In the first instance, the observations should be made upon each boiler separately, using the same description of coal, and keeping the boiler in similar circumstances of draught, &c.

The boilers, as we have previously mentioned, generate a larger quantity of steam than that used in the cylinders, in consequence of the quantity of steam which is lost whilst passing from the boiler to the cylinder and completing its duty there; this quantity of lost steam is, in a great measure, independent of the quantity of steam used in the cylinder, that is to say, that when twice as much steam is used in the cylinder, the quantity of lost steam is not doubled, so that when two boilers are used to supply twice as much steam to the cylinders as was formerly supplied by one of them alone, they will not be each required to generate as much steam as the single boiler did before; but a less quantity, from which it follows that two boilers together will do double the duty that one of them can alone, with less than double the quantity of coal, and consequently a larger economical quotient will be derived from using two boilers than from one, and the larger the number of boilers employed, the larger will be the economical quotient from this circumstance alone; by comparing with each other the economical quotients derived respectively from one, two, three, &c., boilers when supplying useful steam to the cylinders in proportion of one, two, three, &c., we shall be able to find, approximately, the quantity of steam which is lost whilst passing from the boilers to the cylinders and completing its duty there.

By comparing the economical quotients given by different sorts of

coal with each other, we immediately see their relative values for steaming purposes.

Two of the "Swiftsure's" boilers, with ten furnaces, consuming 12·5 cwt. of coal per hour, have an economical quotient of about 10·2. She has six boilers and thirty furnaces; when all these are used with the above economical quotient, they will not consume more than 37·5 cwt. of coal per hour, and in this condition they will supply useful steam to the cylinders in proportion to the number 382·5.

The above table shows that four boilers, with twenty furnaces, consuming 47·295 cwt. of coal per hour, supplied useful steam to the cylinders in proportion of 52·3 × 7·3, or of 381·79; therefore if the six boilers had been used instead of the four, they would have done the same duty, or rather more, and a saving of about 10 cwt. of coal per hour would have resulted; from this, however, we must deduct the coal expended to raise the steam in the two extra boilers.

Let us suspend for the present our remarks on the economical use of the boiler with a good general fact. Many boilers with light fires conduce to economy, and proceed to examine the cylinder in order to ascertain the conditions under which the steam is most efficiently used in it. From the indicator diagrams we can find the mean effective pressure on the piston, as well as the final pressure of the steam in the cylinder, the latter will serve, as we have seen, to measure the quantity of steam used in the cylinder, the former will measure the effect produced by it, and therefore the quotient obtained by dividing the mean effective pressure on the piston by the final pressure of the steam in the cylinder will measure the efficiency with which the steam is used, and we will, therefore, call it the quotient of efficiency.

The mean effective pressure on the piston is the mean pressure of the steam on it, less the pressure on the opposite side of the piston, which is open to the condenser; therefore the more the pressure in the condenser is reduced, the larger will the effective pressure be. It should be remembered that, in consequence of the resistance the steam meets with in passing from the cylinder to the condenser, and being there condensed, the pressure in the condenser is always less than the pressure on the side of the piston open to it, but as they vary together, it is essential to keep the condenser at the temperature which is calculated to produce the best result of which, hereafter, we will say a few words.

An extract from the "Swiftsure's" return, tabulated below, will illustrate the foregoing, remarking that the length of her stroke is 48 inches, and the steam was cut off in all at 5·375 inches from the beginning of the stroke.

Number of boilers and furnaces used.	Barometer.		Thermometer. Fahrenheit.		Pressure in pounds per square inch.				
	Deck.	Mean of Condenser.	Boiler.	Cylinder.	Boiler.	Initial.	Mean effective.	Final.	Back.
	in.	in.	c	o					
4 Boilers .... } 20 Furnaces .. }	30·13	26·53	272·7	269·3	28·6	30·5	11·026	7·3	3·5
3 Boilers .... } 12 Furnaces .. }	29·99	27·0	269·8	266·25	29·37	20·0	6·49	5·0	2·75
2 Boilers .... } 10 Furnaces .. }	30·0	26·3	270·7	266·5	29·75	14·5	4·19	4·5	3·5
Ditto	30·43	25·43	224·6	222·8	6·07	13·75	3·66	4·0	3·8

The first gives a quotient of efficiency.. $\frac{11{\cdot}026}{7{\cdot}3} = 1{\cdot}51$

The second ..... $\frac{6{\cdot}49}{5} = 1{\cdot}298$

The third..... $\frac{4{\cdot}19}{4{\cdot}5} = 0{\cdot}931$

The fourth ..... $\frac{3{\cdot}66}{4} = 0{\cdot}915$

Comparing these with the initial pressures of the steam in the cylinder, we observe immediately that the greater the initial pressure of the steam, the greater the efficiency with which it is used.

The condenser can be kept at its proper temperature by inserting a thermometer in it, so that the readings above 40° F. may be exposed to view, and by using a table calculated from the following formula, which gives the number of degrees Fahrenheit, the temperature of the condenser must be kept above the temperature of the injection water; this number is equal to—

$$0{\cdot}0003\sqrt{\frac{2{\cdot}56(30 + h)(1212 + b - t)p\left\{\frac{4227}{P} + 3710\right\}}{\left(\frac{100 + T}{177}\right)^5 - \frac{p'}{25}}}$$

where h is the height in feet of the surface of the sea above that of the condenser.

b the temperature of the boiler in degrees Fahrenheit.

t the temperature of the injection water.

p the final pressure of the steam in the cylinder.

P the pressure in the boiler.

p' the mean effective pressure on the piston, all expressed in terms of pounds on a square inch.

T the temperature of the condenser; this latter quantity is the one we are looking for, and in order to find T, the best practical way is to assume a probable value of it to be used in the denominator of the fraction, and the quantity calculated from this value and added to t will give a value of T nearer to its real value than the first; proceeding in this way, we quickly arrive at a value which will approach as near to that of T, the proper temperature of the condenser, as we please.

Take for example the second line in the foregoing table, when the "Swiftsure" was using three boilers and twelve furnaces, and we will assume, for the sake of this example, that $h = 20$ and $t = 70°$, and we shall have $30 + h = 50$.

$$1212 + b - t = 1412$$

$$\mathrm{P} = 29{\cdot}37,\ p' = 6{\cdot}49,\ p = 5$$

$$\therefore p\left\{\frac{4227}{\mathrm{P}} + 3710\right\} = 19255.$$

First calculate the numerator of the fraction

log.	2·56	0·40824
,,	50	1·69897
,,	1412	3·14983
,,	19255....	4·28454
		2)9·54158
		4·77979
,,	0·0003	$\bar{4}$·47712
,,	17·7	1·24791

To determine the denominator, we have $\frac{p'}{25} = \frac{6{\cdot}49}{25} = 0{\cdot}2596$; but as T is unknown, the most convenient value to assume for T is the nearest whole number to the numerator just found added to the value of t, this will give T = 87. To find the value of the denominator corresponding to this value of T, we have $\sqrt{\left(\frac{187}{177}\right)^5} - 0{\cdot}2596$ to calculate—

log. 187	2·27184
„ 177	2·24797
	0·02387
	5
log. 1·3163.....	0·11935
„ 0·2596.....	
„ 1·0567.....	2)0·02395
	0·01197
log. 17·7.....	1·24791
„ 17·2.....	1·23594

$\therefore$ T = 70 + 17·2 = 87·2°, the assumed value of T was 87°, and as its exact value is between these two, we need not proceed farther.

At this temperature, the pressure on each square inch in the condenser is equal to $\frac{1}{2}\left(\frac{187}{177}\right)^6$ lbs. = 0·6952 lb., or to 1·39 inches of mercury. The actual pressure was 2·99 inches, therefore it seems probable that a freer injection would have been better.

The pressure of the steam in the boiler should be kept as low as possible consistently with its initial pressure in the cylinder, because the higher the pressure under which the steam is generated, the higher will be the temperature of the boiler and the greater the consumption of coal; a small portion, however, of this increased consumption will be returned, but not the whole, when the steam is separated from the boiler and used in the cylinder, because the steam evaporated in the boiler under the higher pressure from a given quantity of water, being then subject to a lower pressure, will expand to a volume slightly greater than that which would be occupied by steam generated in the boiler at the lower pressure from the same quantity of water, the steam from both being at the same pressure when in the cylinder, but then the temperature of the steam generated under the higher pressure will be much higher than the temperature of that generated under the lower pressure, and so much so, that if sufficient heat were applied to bring the temperature of the steam generated at the lower pressure after it was cut off from communication with the boiler up to that of the steam generated under the higher pressure, in such a way that the pressures in the cylinder remained the same; its volume would be so increased as to exceed the volume occupied by the steam generated under the higher pressure in a greater degree than the former difference.

The following extract from the "Swiftsure's" returns will enable us to compare the force exerted by the engines with the consequent speed of the vessel when she was propelled at different rates, and show how the relation which they bear to each other is determined.

Vessel's speed. Knots per hour.	Number of revolutions of engines per minute.	Mean effective pressure on piston. Pounds per square inch.	Ship's mean draft of water.	Remarks.
13·7	68·1	19·4	Not recorded, but assumed 25 feet.	Light breezes and smooth in all three.
9·9	52·3	11·026	25 feet.	
6	31·37	4·19	25 „	

Neglecting the part of the force exerted by the engines which is employed to work the feed and condenser pumps, and to overcome the friction of the machinery, as being very small in proportion to the whole, and considerably less than the effect produced by the errors of observation, we take the product of the mean effective pressure on the piston, multiplied by its speed, as equal to the product of the resistance of the water to the ship passing through it multiplied by the speed of the ship. We have assumed the draught of water to be the same in the first as in the two observations following it, in order to have them all the same, so that we may be able to consider that we are comparing the same things only in different states as regards speed and resistance, and consequently need only take into account the proportion which the force and resistance, at different speeds, bear to each other, and not trouble ourselves with their absolute values; therefore when considering the force employed, we may leave out of account the area of the piston and the length of the stroke as being common to all, and on the other hand, we may estimate the vessel's speed in knots, and the constant factor of the resistance as unity.

When a vessel is not moving through the water, the resistance we are speaking of ceases, consequently the expression which represents this resistance in terms of the vessel's speed, must be such as to become zero when she stops; therefore if v be the vessel's rate, this condition will be satisfied by our assuming the variable part of the resistance caused by the vessel's motion to be represented by $v\,(a + bv + cv^2 + dv^3 + \&c.)$, where a, b, c, &c., are finite quantities independent of v, and the series is arranged according to integral ascending positive powers of v; the values of a, b, c, &c., which depend upon the form of the vessel, the nature of the surface of her bottom, and her draught of water, &c., must be determined from observations made at different speeds, remarking that if an assumed term, such as dv^4, does not properly belong to the expression we shall find $d = o$.

The observations we have selected give three equations from which the values of a, b, and c could have been found approximately if the series properly contains more than three terms, and exactly if the series terminates at cv^3, and no errors had been made in the observations; but as, in fact, the value of c thus found is small and unsatis-

factory, its existence arising more probably from errors of observation, than its expressing a physical fact which ought to be noticed, I have omitted all but two terms, and have, in preference, taken the mean of the values of a and b derived from the three equations formed from the observations given in the foregoing table as being a better approximation, and thus we obtain—

$$\begin{aligned}
(13{\cdot}7)^2\{a + 13{\cdot}7 \times b\} &= 68{\cdot}1 \times 19{\cdot}4 \quad (1)\\
(9{\cdot}9)^2\{a + 9{\cdot}9 \times b\} &= 52{\cdot}3 \times 11{\cdot}026 \quad (2)\\
6^2\{a + 6 \times b\} &= 31{\cdot}37 \times 4{\cdot}19 \quad (3)\\
a + 13{\cdot}7 \times b &= 7{\cdot}044 \quad (4)\\
a + 9{\cdot}9 \times b &= 5{\cdot}883 \quad (5)\\
a + 6 \times b &= 3{\cdot}651 \quad (6)
\end{aligned}$$

4 and 6 give $7{\cdot}7 \times b = 3{\cdot}393$

$$\therefore \quad b = \frac{3{\cdot}393}{7{\cdot}7} = 0{\cdot}4406$$

4 and 5 give $3{\cdot}8 \times b = 1{\cdot}161$

$$\therefore \quad b = \frac{1{\cdot}161}{3{\cdot}8} = 0{\cdot}3055$$

Examining the composition of the equations, we see that any errors made in the observations from which (5) is derived, have been multiplied by 63 and divided by 98; that those from which (6) is derived have been multiplied by 35 and divided by 66, and that those from which (4) is derived have been multiplied by 87 and divided by 188. Hence—

$$b = 0{\cdot}4406 \text{ value } 77 \times \frac{36}{35} \text{ or } 19$$

$$b = 0{\cdot}3055 \quad \text{„} \quad 38 \times \frac{98}{63} \text{ or } 14$$

and meaning the above values of b in proportion of 19 and 14, we have $b = 0{\cdot}382$, and substituting this value in equations (4), (5), and (6)—

$$4 \text{ gives } a = 7{\cdot}044 - 5{\cdot}233 = 1{\cdot}811 \text{ value } \frac{188}{87}$$

$$5 \quad \text{„} \quad a = 5{\cdot}883 - 3{\cdot}782 = 2{\cdot}101 \quad \text{„} \quad \frac{98}{63}$$

$$6 \quad \text{„} \quad a = 3{\cdot}651 - 2{\cdot}292 = 1{\cdot}359 \quad \text{„} \quad \frac{36}{35}$$

The above values are very nearly in the proportion of the numbers 4, 3, and 2, and meaning in this proportion, we have—

$$\begin{aligned}
1{\cdot}811 \times 4 &= 7{\cdot}244\\
2{\cdot}101 \times 3 &= 6{\cdot}303\\
1{\cdot}359 \times 2 &= 2{\cdot}718\\
&\overline{\qquad\qquad}\\
&9)16{\cdot}265\\
&\overline{\qquad\qquad}\\
a &= 1{\cdot}807
\end{aligned}$$

$\therefore$ $Rv\{1{\cdot}807 + 0{\cdot}382 \times v\}$, where R, 1·807, and 0·382, are constant so long as the draught of water is 25 feet, and the "Swiftsure's" bottom remains in the same condition as when the observations were taken, will represent the relation between her speed in knots and the resistance to her passage through the water.

We shall see, as we proceed, that the value of R, though important for some objects, is not necessary to that we are discussing.

The force required to work the feed and condenser pumps can be calculated from the quantity of injection water used, if means be taken to measure it, and the force which is exerted to overcome the friction of the machine and just keep it moving, can be ascertained sufficiently when turning the engines by hand. Had we known these quantities, or been able to ascertain them in the foregoing example, we should have applied them to diminish the force exerted by the engine, and have obtained better values of a and b; but as the object we have in view depends upon the relative, and not upon the absolute values of a and b, it is only so far as our ignorance of these small quantities affects their relative values that we shall fail in accuracy.

The coal consumed efficiently to produce a velocity v in the vessel, is evidently proportional to the resistance she meets with, and therefore $Bv^3(a + bv)$ will express the efficient coal consumed to produce a velocity of v knots; where a and b depend upon the draught of water, and can be determined in the manner just described, and B depends upon the draught of water and the economical conditions of the engines and boilers and its value can be found in the mode we will proceed to point out.

If we consider the action of the boiler, and remember what has been previously stated, we shall understand that a portion of the coal does not immediately conduce to the speed of the vessel, although it must be burnt in order to render the other part efficient.

1. A portion of the coal is consumed to keep the boilers in their normal condition of giving off steam at the pressure required.

2. Another portion to generate the steam lost whilst passing from the boiler to the cylinder, &c.

Besides a portion must be consumed to provide the force exerted by the engines to work the condenser and feed pumps, &c.

The term inefficient coal may be very well applied to this part of the coal consumed to distinguish it from the other part, which may be supposed to contribute immediately to the vessel's motion, and to be proportional to the resistance she meets with.

Let therefore A be the number of cwts. of inefficient coal consumed in one hour, and $Bv^3(a + bv)$ the efficient coal consumed in the same time to produce a speed of v knots per hour expressed also in cwts.

$\therefore$ $A + Bv^3(a + bv)$ will be the hourly consumption of coal at this speed.

We can ascertain by observation when the vessel and her engines are in a given condition, the speed at which a ton of coal will carry her farther than when the vessel is driven at any other speed, let v' be this velocity and C the quantity of coal consumed in one hour to produce it, the same sort of coal being used throughout, then—

$$A + Bv'^2(a + bv') = C \qquad (1)$$

but v' is the value of v which renders

$$\frac{A + Bv^2(a + bv)}{v} \text{ a minimum}$$

$$\therefore \quad A = Bv'^2(a + 2bv') \qquad (2)$$

$$\text{and} \quad B = \frac{C}{v'^2(2a + 3bv')} \qquad (3)$$

$$\text{which gives } A = \frac{C(a + 2bv')}{2a + 3bv'} \qquad (4)$$

determine A and B in terms of C.

It is important in making the observation to note the draught of water and the economical conditions of the engines and boilers which are expressed by their respective quotients of efficiency and economy which in future we will call the quotients.

Keeping the vessel at the same draught of water, and running her at different speeds, B will only vary with the condition of the engines and boilers, let C_1 be the coal consumed in one hour to produce a velocity v_1, A_1 the inefficient coal, and $B_1v_1^3(a + bv_1)$ the efficient coal, then $A_1 = C_1 - B_1v_1^3(a + bv_1)$ (5).

But B_1 multiplied by the quotients corresponding to the condition of the engines and boilers when the consumption was C_1, is equal to B multiplied by the quotients corresponding to consumption C, and therefore B_1, being known the value of A_1, immediately follows from equation (5), and thus the value of the inefficient coal consumed when the boilers and engines are in different conditions can be found the quality of the coal being the same.

The quantities a, b, and B having also been determined for different draughts of water in the manner described, we can make a table which, when the quantity of coal to be consumed per hour and the vessel's draught of water is given, will show the number of boilers that should be used, and the speed of the ship, the quality of the coal being also given.

This very useful table being constructed, we shall be prepared to find the quantity of coal to be consumed to give the vessel her speed of greatest economy when S, the value of the ship's time, is known.

Expressing the quantity of coal consumed to produce velocity v by $A + Bv^3(a + Bv)$, the value of the ship's time when steaming at this speed will be increased by this amount, so that the value of one hour of the ship's time expressed in coal will now be $S + A + BV^2(a +)bv$, and the most economical speed will evidently be the value of v which gives to

$$\frac{S + A + Bv^2(a + bv)}{v}$$

its smallest value, or when—

$$S + A = Bv^3(a + 2bv) \quad (1)$$

Let v_1 be the value of v corresponding to this condition, and therefore the speed of greatest economy—

$$\therefore \quad Bv_1^3(a + 2bv_1) = S + A \qquad (2)$$
$$\therefore \quad 2Bv_1^3(a + bv_1) = S + A + Bav_1^2 \quad (3)$$
$$\text{and} \quad Bv_1^3(a + bv_1) = S + A - Bbv_1^3 \quad (4)$$

To put these expressions in a practical form, multiply $= ^n$ (3) by a number m, whose value will be determined hereafter, add it to $= ^n$ (4), and divide by $2m + 1$, then $Bv_1^3(a + bv_1) = \frac{m + 1}{2m + 1}(S + A) + \frac{Bv_1^3}{2m + 1}(ma - bv_1)$, take m of such a value as to make $ma = bv_1$ a probable value of v_1 being assumed for the purpose. Then $Bv_1^3(a + bv_1) = \frac{m + 1}{2m + 1}(S + A)$, and as a first approximation, the coal consumed to produce velocity v_1 will be $A + \frac{m + 1}{2m + 1}(S + A)$, take from the table the velocity corresponding to this consumption of coal, and if it is equal to that we assumed, or when substituted for v_1 in the equation $m = \frac{bv_1}{a}$ only gives a slight change to the value of m, we need not proceed further, otherwise replace m by its new value in the expression $\frac{m + 1}{2m + 1}(S + A)$, and find from the table a value of v_1 corresponding to the consumption thus corrected, which will approach nearer to the speed of greatest economy we are seeking, than the previous value of v_1, and by proceeding in this manner we may carry the approximation as near as we please; but generally one or two substitutions will suffice, and this approximate solution be found practically more convenient than the rigid one of finding the value of v_1 from the equation $S + A = Bv_1^3(a + 2bv_1)$.

The trials of vessels over the measured mile might be made, so that a table similar to the above could be constructed and inserted in the first page of their respective log-books.

Throughout the preceding we have considered the vessel to be in calm weather and smooth water, and not acted on by an extraneous force; time will not permit us to enter into this part of the subject to-night, farther than a general statement which may be useful, which is that if v_1 is the speed of greatest economy in smooth water and calm weather, and the vessel be acted upon by an extraneous force such that in order to preserve her speed and keep the vessel going v_1 knots per hour, the quantity of coal consumed in one hour becomes that which if the weather was calm and water smooth would give her a speed of v_2 knots per hour; then if v_3 be the speed of greatest economy under the new conditions, v_3 will always be intermediate in value between v_1 and v_2; also if v_4 be the vessel's speed in smooth water and calm weather, due to an expenditure of S + A cwt. of coal per hour, when the vessel under sail can make v_4 knots per hour, assisting the sails with

steam power in order to increase her rate will be a wasteful expenditure of coal.

The numerous causes which act upon a vessel, her engines and her boilers producing great differences in the general effect resulting from their combined operation tend to perplex an observer by the seeming discrepancies he finds. It is only by patiently considering the causes, and making the observations so that the conditions under which they are made shall as nearly as possible be the same, except as regards the cause and effect whose relation it is the object of the observation to discover, or if a return is to be examined for a similar purpose, to sort them out on the same principle that the quantities upon which the economical consumption of coal we have been considering depend, can be found.

An Officer commanding a steam-vessel who, with the assistance of the best information he can obtain, calculates these quantities in the manner we have recommended, tabulates the results and afterwards, by patiently availing himself of every favourable opportunity, makes observations for the purpose of correcting them, will, in a short time, find he has acquired information which will enable him to reduce the expenditure of his vessel's coal to the lowest possible limit consistent with the duty she has to perform.

Mr. WRIGHT, Engineer in Chief, Admiralty: I do not intend to make any remarks on this paper. The subjects discussed are so deep, and involve so many questions, that a good deal of consideration is required before we can deal with them. As far as I have been able to follow the lecturer, I must say the paper contains some very valuable suggestions, and I should very much like to be able to consider it further, before making any observations on the subject. The lecturer's remarks concerning the economy of steam in the boilers of engines certainly—so far I am able to judge—are very correct, and I hope, by further investigation of the subject, Captain Shortland will be enabled to render us still further assistance.

The CHAIRMAN: After the statement made by Mr. Wright, a most competent authority, that he is unable to criticise the paper for which we are so much indebted to Captain Shortland, I certainly shall not attempt to do so. We must remember that Captain Shortland, unlike many of my profession, has distinguished himself at Cambridge as a wrangler, and he has now, by his careful analysis of this subject, done that which is of the greatest convenience to those who wish to calculate rapidly, reducing to a simple formula, not what we may call a rule of thumb, but a rapid application of what he considers, not a deep calculation, but that which is a calculation, which at the time might involve some considerable expenditure of time, and some considerable mistakes, to a simple form, ready for immediate adaptation and application. After what Mr. Wright has said, I will not attempt to say how much value should be attributed to this paper, but I am sure I agree with Mr. Wright in saying that the subject is one of the greatest interest, and that it has been most carefully worked out by Captain Shortland. We all know at this moment what the value of coal is to ourselves as householders and consumers, and how much greater must be the value of coal to a ship at sea, to a man-of-war having to husband her coal so as to save herself on a lee shore, to engage an enemy, or to bring that enemy to action. It is of the greatest possible advantage that economy should be impressed upon the commanders of those ships with reference to the husbanding and saving of fuel, and that a rapid and careful formula, such as that which Captain Shortland has put before us, should be ready for their application. With these few remarks I am sure I shall interpret the feelings of all present in thanking Captain Shortland for the careful paper he has brought before us.

LECTURE.

Friday, January 30, 1874.

LIEUTENANT-GENERAL SIR J. LINTORN A. SIMMONS, K.C.B., R.E., Governor, Royal Military Academy, Woolwich, in the Chair.

FIELD-ENGINEERING; ILLUSTRATED BY SOME OF THE OPERATIONS OF THE GERMAN ENGINEERS DURING THE WAR OF 1870—71.

By Lieutenant-Colonel H. SCHAW, R.E., Professor of Fortification and Artillery, Staff College.

MR. CHAIRMAN AND GENTLEMEN,—

WHEN last I had the honour of lecturing in this theatre, it was on the eve of that momentous struggle between France and Germany which shook Europe in 1870—71. It might have been expected that such a series of practical lessons in the art of modern civilised warfare as was then exhibited before our eyes, would have set at rest the many vexed questions which previously had perplexed the minds of thoughtful soldiers, and this expectation has been, in a great measure, fulfilled. Even yet, however, are there some points, on which differences of opinion exist, and of these, one of the most important is that which was the theme of my lecture in June, 1870,—the comparative advantages of attack and defence as influenced by modern improvements in fire-arms. On that occasion I endeavoured to show that, theoretically, whatever advantages appertained to the defence under former conditions, those advantages had now grown and increased in a marked degree, and that to attack in front, well-posted and steady infantry, was now a more difficult undertaking than it was in 1775, when 2,500 of the flower of the British Army were twice repulsed at Bunker's Hill by the steady fire of 1,500 undisciplined Americans; or in 1815, when Napoleon's columns recoiled from the British lines at Waterloo; or, later still, when Lee's veterans were compelled to retreat by Mead's purely defensive tactics at Gettysburgh.

I conceive that the theoretical conclusions I then arrived at, have been amply justified by the events of 1870—71. It is true that the French, acting contrary to their national character, on the defensive, were beaten, and the offensive, assumed so boldly by the Germans, was successful; but we must bear in mind the costly sacrifices with which these successes were purchased, the superior numbers of the Germans, their better discipline, their more powerful artillery, their wiser general-

ship, their more perfect organisation, and their more suitable tactics, all of which combined to secure the result. And we must never lose sight of the fact, that fortune will often favour a bold and skilful attack notwithstanding all difficulties, owing to moral causes which are independent of weapons, and to the advantages which are inseparable from a proper use of the initiative.

While admitting all this, however, a dispassionate review of the events of the war, and more particularly of those remarkable episodes in it, the investments of Metz and Paris, brings out in the clearest light the great gain which has accrued to the defence. The unavailing sacrifices of the Germans in their gallant front attacks at Gravelotte, the futile attempts of the French to break through the German lines of investment at Metz or Paris, Von Werder's long thin line of defence which foiled Bourbaki's attempts to relieve Belfort, are but a few of the numerous instances which bear witness to the increased difficulties of the attack.

There is a tendency in the present day, however, to condemn defensive tactics and to maintain that improvements in fire-arms have really given a preponderance to the attack rather than to the defence. If this be so, what means the almost universal cry for new offensive tactics—the acknowledgment that the old advance in line or column is now impossible? It means simply this, that an assailant, however numerous, brave, and skilful, cannot *rapidly* advance against a thin line of infantry armed with breechloaders, and properly supported by the other arms. He must, by suitable tactics, gradually accumulate a superior force within close rifle-range of them. He must pound them by his artillery, and sting them by his ever-increasing swarms of infantry, before he can hope to dislodge them by an attack in front. He cannot march up his troops at once in overwhelming force, whatever formation he may adopt, as he could have done in former days. This power, which is now in the hands of troops acting on the defensive, of delaying the attack for a very much longer time than formerly, is the fact that has been established beyond the possibility of a doubt, and the acknowledged necessity for a new method of attack requiring more intelligence, skill, and discipline on the part of the assailants, and *more time for its execution* than formerly, is but the practical confession that the attack is more difficult than formerly, or that the defence has gained in power.

Believing, then, as I do in the increased power of the defence, and that now, as heretofore, our national tactics, those which are best suited to our stubborn temperament and comparatively small numbers, ought to be primarily defensive (I speak of civilised warfare), whenever we can compel our enemies to attack us, I consider that field fortification, which lends its aid chiefly to the defence, has correspondingly increased in importance; I have therefore willingly acceded to the request of the Council of this Institution to give a lecture on "Field-Engineering," a branch of military duty which includes not only field-fortification properly so called, but also a comparatively new and highly-important class of duties connected with the movement of armies and involving the double problem of facilitating those of one side and of retarding those of the

other, by maintaining or obstructing, creating or destroying roads and railroads, with their bridges and defiles. Telegraphs also, and frequently the rivers and canals of a country, and the arrangements necessary for embarking or disembarking on foreign shores, must also be considered under this head.

In fact, field-engineering now embraces so many subjects that to attempt to treat it in all its branches within the time during which I can hope to win your attention, would be out of the question. I consider, therefore, that it will be most profitable if I confine myself mainly to the consideration of those branches of field-engineering which concern the defence and attack of positions, and to what may be termed the ordinary pioneer duties of an Army, omitting the special subjects of telegraphy and railways, and the technicalities of pontooning and of siege and mining operations. This course appears the more suitable, as railways and telegraphs have formed the subjects of very valuable lectures which have lately been delivered here.

In order to give as practical a value as possible to the observations I shall have to make, I propose, in the first instance, to bring before you some of the field-engineering incidents of the late war between France and Germany, making use of a German work of which I have lately been engaged in drawing up a *précis*, viz., "The Operations of the "German Engineers and Pioneers in the War between Germany and "France in 1870—71, by Captain Adolphus Goetze, of the Prussian "Engineers." From this work I will give some extracts to show the character of the field-engineering operations performed during the advance into France and the earlier battles, then some of the details of the investment of Metz, and finally some of the defensive arrangements made in the vicinity of Rouen. But first it will be necessary to draw attention to two remarks of Captain Goetze after detailing the organisation of the German Engineer Corps. He says, "The numerous "demolitions of railways and bridges, and preparations for passing "rivers, needed during the course of the operations of the Ist Army in "the North of France, point to as perfect mobility as is possible, and "a perfect equipment being given to individual *sections* of Engineers." From which remark we may infer that the German companies of 200 men each were found to be units inconveniently large for this branch of the service, and that whatever may be the case as regards the infantry generally, our smaller engineer companies cannot be enlarged with advantage. On the contrary, it is evidently essential that the equipment of engineer companies should be so organised that subdivisions or sections of companies which are liable to be detached on special duties should always take with them, as a matter of course, a sufficient supply of necessary tools and appliances for the works they may be called upon to perform. Captain Goetze recommends further that "Special detachments of engineers should be equipped to accom- "pany cavalry." This is not a new idea, it has already been strongly advocated in our own service, the object being that cavalry may be given the means of performing efficiently one of their most important duties in modern warfare, viz., that of sweeping round the flanks of an enemy, getting in rear of him, and interrupting his communications by

destroying some important link, such as a railway viaduct. Such work cannot be thoroughly done by men, however gallant, when provided only with sabre or lance and carbine, nor even by the Horse Artillery, who may accompany them. Such minor injuries as they may be able to effect may often be worse than useless, because, as Captain Goetze remarks, "Generals are easily induced by information of such demo- "litions having been effected to consider the use of the railway so "injured to be impossible to an enemy, and to make their dispositions "accordingly; whilst, in reality, a few hours' work may generally make "an imperfectly destroyed railway passable again." And the truth of this remark was frequently proved during the course of the campaign. It has been proposed that these "Horse Engineers" should be mounted, but for many reasons it seems preferable that they should be carried on waggons, or on cars, such as those used by the Wiltshire yeomanry; because the number of horses, and of men to hold them, would be much fewer, and the dress of the men might be made more suitable to their work which would, of necessity, always lie near roads. The waggons or cars carrying the men and their tools and appliances should, of course, be sufficiently well horsed to keep up with Horse Artillery. Probably four 4-horse waggons would suffice to transport men and tools for any ordinary works of demolition.

We will now follow the German Armies for a short time, and notice the field-engineering operations performed during the marches and battles at the outset of the campaign.

In the account of the active operations of the mobilised German Armies, we will follow first the movements of the Ist and IInd Armies up to the passage of the Moselle.

The engineers began their work by a reconnaissance made by the engineer staff in advance of the Army, of the course of the Moselle, from Coblenz to Treves, in order to prepare the necessary passages of the river; these were made at Berncastle and Schweig, out of materials obtained on the spot, and as the VIIth corps took up its position on the Saar, this river was also bridged on the 31st July, at Mettlach.

After the fight at Saarbrücken, we learn that in the course of the 8th August the position so dearly won at Spicheren was fortified, lest the enemy returning in force should regain what he had lost. The fortifications consisted of gun-pits north of Spicheren, of abattis formed along the edge of the wood of Spicheren, and of fortifying the village of Etzling, but the works were not completed, as the news of the retreat of the French made them unnecessary.

Before the Ist Army reached the French Nied, five bridges had been extemporised, without making use of the pontoons, in addition to the ten bridges already existing, so that 15 passages were available for all arms in the vicinity of Etangs, Pange, and Courcelles.

At the battle of Borny (or Courcelles) we find two pioneer companies fighting in the first line with the 13th infantry division, and sustaining heavy losses in that hardly fought action, although from the circumstances of the case there was little scope for their employment in their own special duties.

Passing now to the operations of the IInd Army. While the main

body of the Army was moving towards the Moselle, several reconnaissances were made in advance of it. Of these, two are interesting. A young engineer Officer was sent from the head-quarters of the Xth Corps, then at Hellimar, about 40 miles from Pont-à-Mousson, with an escort of hussars, to cut the communications by telegraph and railway between Pont-à-Mousson and Nancy. They reached their destination, and succeeded in cutting the telegraph wires without difficulty; but the attempt to injure the railway was frustrated by the appearance of some French infantry, and by insufficiency of means—a case quite to the point with reference to the necessity of equipping engineers to accompany cavalry before alluded to. The head was there, but the skilled hands, the tools and materials were wanting.

This reconnaissance, however, and another made on the 13th by the engineer staff of the IInd Army, found the bridge at Pont-à-Mousson intact, and also discovered other good bridges south of that place, *the existence of which was not before known.* A curious evidence that the German maps of France were not as perfect as has been supposed.

On the 14th and 15th, the engineers of the IInd Army were employed in fortifying Pont-à-Mousson, to secure this important passage. The defences consisted mainly of garden walls, and hedges prepared for infantry, of emplacements of artillery, and of clearing the ground in front, over which the French would have to advance to the attack.

For the passage of the Moselle by the German Army, only four bridges were available, viz., a suspension bridge at Corny, and the substantial bridges at Pont-à-Mousson, Dieulouard, and Marbach. None of these had been injured by the French, nor were they guarded. But they were by no means sufficient for the purpose; it was therefore ordered that they should be supplemented, and on the 13th August two additional bridges were constructed by the engineers of the Xth and IIIrd Army Corps, one at Pont-à-Mousson, the other at Champey. These bridges were made with the light bridge equipments, which were not calculated to carry artillery or waggons; however, that at Pont-à-Mousson was strengthened by materials obtained there, and made passable for all arms.

By the evening of the 16th, two more bridges were made near Champey, and by the evening of the 17th, four more near Arry and Corny. Thus in all, on the evening of the 17th August, twelve bridges were available, and the pontoon trains now at hand afforded the means of rapidly making eight more bridges, should a passage north of Metz become desirable.

An interesting question regarding the passage of rivers may here be noticed. The number of bridges required to ensure there being no loss of time in crossing a river depends evidently on the number of roads by which the Army approaches the river, and at first sight it would seem sufficient that each road which reaches the river should have its bridge, and a continuation of the road on the other side; but the width of the road, as well as its condition, and the character of the country through which it passes, must all be taken into account before the necessary number of bridges can be decided.

In countries, such as many parts of France, where the roads are

broad and good, and the land on either side unenclosed, it may be possible to march a double column of wheeled carriages on the road, and to move infantry and cavalry during dry weather, in the fields beside the road. To secure there being no check to a column moving on so broad a front as this, when it reaches a river, it would be necessary, in case the regular bridge were broken, to make at least four pontoon bridges, and to provide approaches to them on both sides of the river. Even were the regular bridge intact, two supplementary bridges would be required for the troops moving on either side of the road. Permanent bridges, too, are often narrower than the roads they serve, and additional bridges may consequently be required to avoid delay in military operations. On the other hand, should the roads be narrow and bad, passing through forests and swamps, as was the case very generally in the late American war, it will frequently happen that one bridge will keep two or more roads employed. Thus, in the records of the engineer and artillery operations of the Army of the Potomac, Brigadier-General Woodbury reports that to keep the bridge at Whiteoak Swamp fully employed, he made four roads converge upon it, and three diverge from it, and by this means he was able to pass over 3,000 waggons in 24 hours. The roads were doubtless what are familiary known as "corduroys," on which travelling is slow, and break downs of frequent occurrence.

During the battles of Mars-la-Tour and Gravelotte there was not much scope for engineering operations. In the former, some of the pioneer companies fought with the 57th Regiment, and did good service. During the progress of the latter, some of the pioneer companies were employed in fortifying the villages of Gravelotte, Verneville, and Mercy, to act as rallying points in case of a reverse. The pioneers of the guard fought with them at St. Privat; those of the VIIth Corps were left to guard the bridges at Corny, and while the XIIth Corps was attacking Roncourt, the senior engineer Officer of this corps was sent with a detachment of pioneers and a cavalry escort, *viâ* Briey, to Mercy-le-bas, for the purpose of destroying the Thionville-Montmedy Railway at that point. The railway was reached during the night of the 18th—19th August, and before daybreak the telegraph was destroyed, the rails broken up for a considerable distance, and the chairs sunk in a stream. More complete demolition was prevented by the approach of French troops from Thionville.

On the 26th August, news reached head-quarters that the French had left Chalons, and were moving northwards. New dispositions to meet this became necessary, and the XIIth Corps (afterwards joined by the Guard Corps) took up a defensive position on the line Dun-Stenay, to check any attempt of the French under MacMahon to gain Metz by this route.

The engineers strengthened this position by barricading or destroying bridges, making others to improve communications within the position, and constructing various defensive works. It is to be observed that where the Meuse was fordable in the vicinity of bridges, the latter were not destroyed, only barricaded. This showed a wise discretion on the part of the directing Officers. To destroy a bridge over a fordable

river in front of a position does not hinder the attack of the enemy's infantry, while it may seriously impede the passage of the river by the defender's artillery, and perhaps their cavalry also, for a counterstroke, or a forward movement.

During the actions of the 30th and 31st August, culminating in the catastrophe of Sedan, the engineers of the Army of the Meuse not only constructed and restored many bridges over the Meuse and the Chiers, but also fought with the infantry in the storming of Beaumont and Mouzon.

We now go back to follow the fortunes of the IIIrd Army up to this same point.

Previous to the action of Weissenburg, it appears that the advanced guard of the Bavarians was ordered to seize the old fort of Weissenburg, but that they found the place too strong for them, and their supports being far behind, they feared lest a sortie in force might lead to a defeat. Their engineers were therefore ordered to fortify the village of Schwaigen to protect their retreat, and this was accordingly done, although the timely arrival of the Vth and XIth Corps on the scene rendered the fortifications unnecessary.

When the XIth Corps arrived before the French position at Wörth, the Commanding Engineer Officer strongly urged that the light bridge train should at once be brought up for the passage of the Sauer. The General, however, did not accede to his request, which appears to have been a mistake, as considerable delay and loss occurred in crossing the stream. The pontoons did not arrive until 1 P.M., but the 3rd pioneer company succeeded in constructing three foot bridges out of hop poles at Spachbach, much earlier in the day, by which the first troops crossed. These bridges, although occasionally injured by French shells, were of great value, and saved part of the Vth Corps from disaster, when they were forced back from their first unsuccessful assault on Frœschwiller. As soon as the village of Wörth was carried by the Vth Corps, the 1st pioneer company attached to them repaired the three bridges over the Sauer, in that village, which the French had destroyed. The 2nd pioneer company also made two additional bridges below Wörth, out of such materials as could be found there. During the execution of these works, both companies suffered severely from the French fire; but their heaviest loss occurred in the storming of the Weinberg. The engineer Officer who was repairing the bridges in Wörth when he saw the Vth Corps being driven back, gathered hastily his men from the bridges, formed them into a detachment with the stragglers from the infantry who had found their way back into the village, and pushed on with the other troops who were advancing to the second and successful attack of the French position. The 3rd pioneer company, who in the march towards Morsbronn early in the day had formed square with a section of infantry, to resist a charge of French cuirassiers, were employed in preparing a rallying position for their brigade should they fail in their attack on Morsbronn.

During the advance of the IIIrd Army it became necessary to provide means for passing Bitsche and Toul, and roads were accordingly made round these fortresses by the pioneers; that round the former,

METZ

Gandrange
Rombas
Hagondange
Talange
Hauconcourt
Maizières-les-Metz
Malancourt
Montois
la-Montagne
Marange
Roncourt
Bronvaux
St Privat-la-Montagne
Amanvillers
Montigny
le Granier
Sanlizy
Woippy
St Eloy
Vernéville
Plappeville
Devant
les Ponts
Metz
Longeville-les-Metz
Moulins
les-Metz
Montigny
les-Metz
Gravelotte
Rozerieulles
Jussy
Bois
Scale 1/80.000
0 ¼ ½ ¾ 1 2

Stanford's Geog.l Estab.t Charing Cross London.

2 3 4 English Statute Miles.

Entanglement. *Places occupied by the French at the time of the first closing of the investment are surrounded.*

six miles in length, was so far completed in two days' work, that the Bavarian Corps marched along it on the 10th August.

As the various corps concentrated around Sedan, the engineers were employed in bridging the Aisne and the Meuse (the latter here a stream about 65 yards wide and 12 feet deep), and in destroying the bridges and railways that might be of use to the French.

On the 1st September the Army of the Meuse had seven bridges in its possession above Sedan, while the IIIrd Army had four bridges below it. Some of these bridges had been made under fire. The pontoon trains had sufficient material close at hand for the construction of two more bridges below, and five above Sedan, which could have been made, if required, in little more than half an hour.

During the course of the battle of Sedan, the pioneers of the IVth Corps constructed a number of small foot bridges over the streams and ravines east of Bazeilles. The pioneers of the XIth Corps took part in the attack on Floing, and by loopholing walls, &c., made the village susceptible of so strong a defence, that all the French attempts at retaking it failed. On another part of the field a pioneer company in line with some infantry repulsed an attack of French cavalry, and during the night of the 1st and 2nd September, the pioneers of the IVth Corps secured the railway bridge over the Meuse by entrenching a position between it and Bazeilles. The village itself, being in flames, could not be fortified.

After the capitulation, Sedan was put into such a state of defence as to make it safe against any attempt to recapture it by a *coup de main*.

We now return to Metz. There is something so novel in the fact that a great Army was shut in within the defensive lines of a permanent entrenched camp until it was starved into capitulation by another Army, numerically very little its superior, and that the Army so shut in, was apparently unable to derive any advantage from its position which hitherto has been supposed to give it a great superiority, that this first great practical example of this special phase of modern warfare is full of interest and instruction.

Captain Goetze's account of the investment begins with a general description of the fortress and its environs, in which the following points are of chief interest. The French had only three bridges over the Moselle within the fortress, and one of these was a suspension bridge, apparently unsuitable for heavy traffic. The railway bridge near Longueville they had blown up, although it was within their lines. This is a most remarkable fact, that only such very limited means of passing the river should exist in a fortress, the primary object of which was to give to the Army holding it, the means of rapidly concentrating for offensive action on one side or the other of the stream, and that one of the bridges should have been recklessly destroyed just when the opportunity for using it to advantage had arrived.

The Moselle near Metz is from 150 to 250 yards wide, and its depth is ordinarily from $2\frac{1}{2}$ to $3\frac{1}{2}$ feet, but it rapidly rises 10 feet above its ordinary level during rains. We learn from other sources that all the French pontoons were at Strasburg. Trestles were therefore used by

the French for extemporising additional bridges, and these are peculiarly liable to be carried away by floods.

The character of the country to the west of Metz is very different from that of the ground to the east of the fortress, the heights on the left bank of the Moselle being so steep, that large bodies of troops can only move by the high roads, while to the eastward the open and undulating character of the country offers every facility for extended military movements.

Hence it is deduced that Metz was more dangerous to Germany when in French hands, than it is to France now that it is a German fortress, because it is so much easier to debouch from it to the east than to the westward.

At the time of the investment, the detached forts were not completed. St. Quentin and Plappeville were the most advanced, and might be considered secure against assault, as their ditches were cut out of the solid rock. The escarps of St. Julien and Quentin were nearly finished; but their counterscarps were unrevetted, and their gorges were not closed. None of the forts were fully armed; but they were all designed to receive a very numerous and powerful artillery.

Although the French Army in Metz was provisioned for a much longer time than the Germans imagined, yet the difficulties of conducting a regular siege against one of the detached forts of a large entrenched camp occupied by an Army, are so great, that there can be little doubt that the investment led to the desired result quite as soon as, and with far less loss to the Germans, than any other course they could have pursued. The defence of Belfort, which held out for 102 days before its detached forts were taken, although these were only field works and the garrison almost entirely Mobiles, is a modern example. The gallant defence of Silistria by the Turks under the inspiration of a few English Officers when besieged by the Russians in 1855, is an earlier example, which shows perhaps better the peculiar difficulties inseparable from the sieges of great entrenched camps.

An investment having been decided upon, and the general line to be taken up having been fixed, after a reconnaissance by Colonel Leuthaus, the Commanding Engineer, the following instructions were issued on the 20th August for guidance in fortifying the positions:—

1. "Enclosed redoubts are to be sparingly used. Only when "isolated points must be occupied, and it is desirable to give better "protection against artillery fire (which naturally will be directed "upon them), than shelter trenches or gun emplacements. On the "other hand, the most extensive use is to be made of shelter trenches, "and also of emplacements for guns to flank the shelter trenches, and "to defend the more distant ground, more especially the important "roads.

2. "The valleys crossing the line of investment and the roads "leading into Metz are to be blocked up by as strong abattis as "possible.

3. "The edges of woods parallel to the line of investment are to be "felled and made as impassable as possible.

4. "When the line of investment passes through a wood, a belt is

" to be felled from 50 to 100 paces wide, the edges are to be formed " into an entanglement, impenetrable even by single skirmishers.

5. " Good communications between the different sections of the " investment are exceedingly important. Roads are therefore to be " made through woods parallel to the investing line, and also to the " rear when required, and to be improved progressively."

Since it was possible that the waters of the Moselle might be used by the French for sending or receiving letters, enclosed in bottles or other floating vessels, a wire net was stretched across the river north of Ars to act as a " bottle catcher." Booms and nets were also anchored both above and below the bridge at Hauconcourt.

In order to obtain the earliest possible intelligence of the movements of the enemy, and thus to have the power of reinforcing threatened points in good time, observatories furnished with powerful telescopes, were established in accordance with Prince Frederick Charles's instructions, some at the beginning, and others during the course of the investment. Officers of different branches of the service were appointed to these observatories who carefully watched the French camps, bridges, and roads. The six principal observatories were on the bluff west of Jussy, on the Horimont, at St. Barbe, on the hill south of Montoy, at Mercy-le-Haut, and at St. Blaise.

On the 20th August the fortifications of the investing line were commenced in earnest and were carried on almost without intermission until the end of the investment, either in strengthening the works already commenced or else in making alterations or corrections which became necessary in consequence of the frequent changes in the disposition of the investing troops. Each new General or Commanding Engineer had different views from his predecessor, and ordered demolitions or new traces. The changes in the " general situation " consequent on the course of the campaign, and the probability of sorties in different directions, led chiefly to these changes in the positions of the investing corps.

The positions to be defended were, as a rule, decided on by the Division or Corps Commanders in consultation with their Commanding Engineers. The works were executed by the pioneer companies, assisted by working parties of infantry, which were detailed generally by battalions or companies. The infantry pioneers were not employed to any extent before Metz. Of the men organised as infantry pioneers, few remained after the previous bloody battles, and those few could not be spared from their regiments, which were all short of men. Entrenching tools, too, were wanting, most of them having been lost or having become unserviceable.

During the first days of the investment, the investing corps were not molested at all by the French in their work, as the latter were themselves fully occupied in reorganising, and were quite unfit for energetic operations. But on 26th August, Marshal Bazaine intended to make an effort to break out towards Thionville on the right bank of the Moselle, and with this design the 4th French Corps were moved to the right bank on the 24th. The passage of the other corps on the 26th was delayed considerably, because the necessary approaches to

the temporary bridges which had been made, had not been prepared; this led to crossing of the columns and much confusion. The bridges also were too slight for wheel traffic, and thus it was mid-day before the troops had crossed. Soon after this, the French began to mass considerable bodies of infantry in front of the line Malroy-Charly, and also for an attack on Servigny, and to cover their advance by skirmishers who fired at long ranges with little effect.

As soon as they became aware that the Germans had considerable forces and a numerous artillery in position, they desisted from the attack and encamped near fort St. Julien. Heavy rain which set in, apparently aided materially in bringing about this result.

On the 31st August, from all the German observatories, great movements of the French troops were noticed. These movements, as since learnt from French sources, were as follows: The 3rd Corps on the line Grigy-Nouilly; the 4th Corps between Mey, Villers l'Orme and Grimont; the 6th Corps *à cheval* of the Bouzonville road; the 2nd Corps as reserve to the right wing from the hamlet of Belle-Croix stretching across the ravine of Vallières. The Guard and Reserve cavalry between fort St. Julien and the wood of Grimont. The right wing was to begin the engagement, and inclining to the left to unite with the left wing in seizing the position of St. Barbe, and thus to gain possession of the roads leading to St. Barbe, Vigy, and Bouzonville.

The movements of the French troops began at 6.30 A.M.; but, as on the 26th, they were so badly arranged that the columns frequently crossed in their march, and it was not until 1 P.M. that three divisions of the 3rd Corps, and two divisions of the 4th Corps were ready in first line for the attack. Marshal Bazaine considered it necessary to prepare the attack by the fire of heavy artillery, and accordingly he had batteries for guns of position thrown up to the left of the St. Barbe road, which were not ready until between 3 and 4 P.M., when fire was opened from them.

The time thus accorded to the Germans to prepare to resist the attack was not thrown away. The General commanding the 1st Army ordered the 28th Infantry Brigade to march at 7 A.M. from Pouilly. General von Manteuffel moved the 3rd Infantry Brigade from Courcelles to Puche and later to Retonfay, and *held the position Mercy-le-Haut, Aubigny, Colombey with only one brigade.* The 3rd Cavalry Division was concentrated at Retonfay. The Landwehr division was brought up to St. Barbe. Before noon Prince Frederick Charles ordered the 25th Division to cross the Moselle, the remainder of the IXth Corps to concentrate at Roncourt. The IIIrd Corps to march to St. Privat, IInd Corps to remain in readiness between Auboué and Briey, sending a detachment to Aumetz.

Although it was late in the day before the French attack really commenced, yet at 9 A.M. they had assailed the German left wing with about eight battalions and a numerous cavalry, and had obliged them to evacuate Colombey. The Germans continued to occupy Mercy-le-Haut and Aubigny. A short artillery duel took place on the right wing at about 10.30 A.M. From this time until the position battery on

the left of St. Barbe road near Grimont opened fire, they remained inactive; but they then resumed the offensive, and at 6.30 P.M. they had gained possession of Noisseville and la Brasserie, driving out the German battalion which held these villages, and had obliged the German artillery to retire from Servigny.

At 9 P.M. Noisseville was once more in the hands of the Germans. At 10 P.M. the whole French line advanced, and gained possession of Flanville, where they were only opposed by a few cavalry. La Brasserie soon followed, and Noisseville was once more occupied by the French. A concentric attack on Servigny gained this point for the French also, excepting the few last houses which the Germans still held, and which acted as a starting-point for their counter-attack, in which they succeeded, clearing the village completely of French troops. Failly and Poixe were firmly held by the Germans, although repeatedly attacked by the French.

At 11 P.M., the battle was over, leaving the German main position unbroken, viz., Malroy, Charly, Failly, Poixe, Servigny.

On their left wing they had lost ground, having been driven out of Noisseville, La Brasserie, and Flanville. The French had, therefore, only succeeded in the preliminary portion of their programme.

During the night of the 1st September, the 18th Division IXth Corps was sent to support General von Manteuffel, and on the following morning the greater part of the Xth Corps was also ordered to march in the same direction, so that the General was able to take active measures to regain the lost positions. Early on the morning of the 1st September, Noisseville was retaken after a heavy bombardment and three unsuccessful assaults. Flanville and Coincy were not so strongly held, and were retaken soon after 9 A.M. by the 28th Infantry Brigade, which had marched from Puche at 6 A.M., and which then established itself *à cheval* of the Saarbruck road, and in this position repelled several French attacks. Other portions of the VIIth Corps also arrived during the course of the 1st September to support the left wing of the Ist Corps. On the German right, the French recommenced the engagement at 9 A.M., and repeatedly attacked the fortified villages of Russigny and Failly without success. At length, the German 3rd Reserve Division with the Reserve Brigade which occupied the wood of Failly, advanced out of their fortified position at Malroy, Charly, and drove back the enemy into the wood of Grimont. At 11 A.M. the French made a final effort, and attacked the position Poixe-Servigny in two lines, but without success.

In reviewing this first great sortie of the French, we notice first the value of the German defensive works on the greater part of which they had been employed for ten days. On that part of the line which was carried by the French, less labour had been expended than on any other part, it was but weakly garrisoned, and in their attack on it the French had material aid from the cover given by the features of the ground. Secondly, nearly all the French successes took place during the dusk, or in the dark, and the German counter-attacks were then also most successful. The three abortive attacks on Noisseville after it had been heavily bombarded on the morning of the 1st September, show the

immense advantage the defence derives from cover during daylight, and point to the advisability of practising night attacks on localities—a lesson learnt from many other episodes of the war, and notably from the struggles for the possession of Le Bourget during the investment of Paris.

On the 27th September, Strasburg fell, setting free the newly-formed XIVth Corps. Toul also had surrendered on the 23rd. In consequence of these events, it seemed very unlikely that the French would now seek to break through the line of investment towards the South. Towards the West, the natural difficulties of the ground, combined with the German field fortifications, made any effort of the French on a large scale hopeless. The only chance which seemed to remain to them was to repeat the programme of the 31st August, and to endeavour to escape northwards by the right bank of the Moselle. It seemed so probable that Marshal Bazaine would make this attempt, that the German arrangements were at once made to prevent its success, which, however, they considered quite possible.

The advantage to the French would undoubtedly have been great had 70,000 or 80,000 good troops succeeded in reaching Thionville.

There they could have been provisioned for at least eight days, and they might then have crossed the Belgian frontier, and thus have escaped being made prisoners, while Metz, relieved of so many mouths, might have held out for several weeks longer.

To be successful, however, the attempt should have been a surprise, carried out with vigour against both the north-east front and the valley of the Moselle.

The new German dispositions for strengthening the line on the north-east were hardly completed, when, during the night of the 1st—2nd October, the 6th French Corps attacked the outposts in the Moselle Valley, and soon overcame the resistance of the weak piquets in Ladonchamps and St. Agathe. The posts at Bellevue, St. Remy, and Les Tapes were stoutly maintained with the aid of the position artillery.

Several counter-attacks against Ladonchamps failed, the French having rapidly entrenched themselves in the buildings which were surrounded by a wet ditch, and having also connected themselves with Woippy by a trench. They also commenced to build a battery in the park of Ladonchamps. St. Agathe was retaken in the morning; but owing to its proximity to Ladonchamps, it could not be maintained. This partial success was not of much real value to the French, although they obtained a small supply of provisions from St. Agathe. The Germans contented themselves for the present with shelling Ladonchamps, but preparations were made for attacking it in force on the evening of the 7th October, the 2nd Pioneer Company of the Xth Corps being charged with the destruction of the post as soon as the French should be driven out. These arrangements were upset, however, by a French attack earlier on the same day. At about 1 P.M. their columns debouched from the wood of Woippy, from Ladonchamps, and from the two Maxes, and after a hard fight they drove back the advanced guard of the Landwehr Division from Bellevue, St. Remy, and the two Tapes.

As soon as the attack was observed, the 38th Brigade of the Xth Corps was moved across the Moselle, and the 9th Brigade and two batteries of the IIIrd Corps were also placed at the disposition of General Kummer, who was thus able to assume the offensive at 4 P.M. The French fought hard and gave way slowly, but before nightfall, the Germans had recovered their old positions, occupied the wood of Woippy, and had even endeavoured to retake Ladonchamps; but in this last attempt they failed. Demonstrations had been made by the French at the same time in many other parts of the line; but they had not been pushed beyond skirmishing.

In this last great sortie of the French from Metz, we notice that their successes were obtained over an advanced guard only, *i.e.*, a whole French Corps, after a hard fight, obtained possession of the fortified outpost line of a German Corps; but beyond this, they were unable to push their advantage. The strongly-fortified main position, Fêves, Sémecourt, Amelange, lay a mile to their front, and the German field- and position-artillery in battery in it, crushed every attempt of the French to debouch from the outpost line they had won. The German outpost line had, therefore, answered its purpose well, gaining sufficient time for the German troops to assemble in their main position; but it would be extremely interesting to know at what cost this time had been gained, and what were the losses of the advanced guard in retreating to the main position.

Let us now see what was the character of the fortifications of the investing lines. The statement has been made that the Germans neglected fortifications, and trusted mainly to hard fighting in the open, in order to retain the French within the circle drawn around them. That this is a very mistaken idea will be apparent from the diagram which shows the defences actually constructed on a part of the line of investment, and which may be taken as a fair sample of the whole line.

The extent of the investing line was about 25 miles. It was divided into seven sections, which averaged a little over three miles in length. Each section was, as a rule, entrusted to an Army Corps of 25,000 infantry, besides cavalry and artillery, which gives an average of at least 7,000 infantry per mile, supposing the battalions to have been kept up to their war strength.

Very complete descriptions are given of all these sections of the investing line, with the troops detailed for their defence, and the fortifications constructed to strengthen them. Of these the northern section is selected as typical, because on it and on the neighbouring section on the N.E., fell the brunt of the French attacks.

The northern position extended across the Moselle valley from Fêves to Amelange and the Moselle, a distance of about 7,000 paces, resting its right flank on the spurs of the heights which border the west side of the valley. These heights are broken by numerous ravines, and are clothed at this point by woods, which give cover for the assembly of hostile troops—more particularly is this true of the wood of Woippy. In front of the centre and left, the valley stretches for 2,000 paces level and open; the view being only interrupted by occasional farmsteads, or châteaux, &c., viz., Ladonchamps in front of the centre, a

château surrounded by wet ditches and a thickly wooded park; to the west of this St. Agathe, and to the north of it St. Remy. In front of the left wing, the farmsteads and hamlets of Franclochamps, Les Maxes, and les Tapes, all solidly built; but all exposed to the fire of forts Plappeville and St. Julien.

The plain is everywhere passable for all arms, the only obstruction being numerous small wet ditches. On the right wing the north-west spurs of the Horimont and the heights about Marange afford excellent artillery positions, from which an attempt to pass round this flank can easily be prevented, even should the villages of Saulny, Plesnois and Norroy be lost, more especially because the difficult nature of the ground forbids the deployment of large bodies of troops.

Fortifications.—In the main position, the villages of Fêves and Sémecourt, the small poplar wood west of the railway, the churchyard of Maizières and the farmstead of Amelange were the strong points connected by abattis or shelter trenches.

In rear of the main position, Marange was fortified to protect the roads leading to the plateau of St. Privat; Maizières was also fortified as a supporting point in the plain, and Hauconcourt as a bridge-head. For the execution of the works seven companies of pioneers were at first available, assisted by working parties of infantry.

Work was commenced on the 21st August, when the *line of outposts*, Bellevue, St. Catharine, Point-du-Jour on the right, with the still further advanced post of St. Agathe, were made defensible. On the left, a line of outposts was at first occupied, passing through Ladonchamps and Les Maxes (this was afterwards given up as too exposed).

On the 22nd, the fortifications of the *main line* were taken in hand by loopholing and preparing for defence suitable buildings and walls, and making shelter trenches to connect them. The artillery made a battery for six guns between Amelange and Maizières. On the 24th and 25th, the engineers built two batteries, one for 12 guns between the railway and the churchyard, enfilading the railway and roads—Metz-Thionville—the other between Amelange and the Moselle for eight guns to fire across the ground in front of the position. During the night of the 25th—26th, the farmsteads Grandes et Petites Tapes and the château of St. Remy, were prepared for defence and occupied as outposts, and later, the still further advanced posts of Ladonchamps, Franclochamps, Grandes and Petites Maxes were again occupied and strengthened. The chief attention was, however, directed to the defences of the centre of the main position, on which a working party of 600 infantry, in addition to the pioneers, was employed daily. They strengthened the walls of the churchyard by earthen parapets, cleared the ground in front of the position, and cut roads for communication through the woods in rear, and by the 27th August this position was considered to be thoroughly defensible; the works were however, continued without intermission, and strengthened everywhere, more military roads made, and epaulments thrown up to shelter the reserves.

On the 31st August, the defences of the right wing of the main position were commenced by fortifying the villages of Fêves and Sémecourt.

At Fêves the outer edge of the village was made defensible, the field of view cleared in front of it, and a 6-gun battery built in the re-entering angle to flank the lines, Fêves, Norroy and Fêves-Sémecourt. These two lines consisted chiefly of abattis, with a few infantry trenches. At Sémecourt only the western outskirts of the village were made defensible. The line on the south and east was pushed on 600 or 800 paces to the edge of the plateau; thus a sort of bastion was formed, from which the whole position as far as the Moselle could be most effectively flanked by a 6-gun battery which was built here. A long line of shelter trench farther down the slope of the hill with obstacles in front of it, completed the defences at this point.

On the 2nd September a battery for 10 rifled 12 c.m. guns* was commenced on the high ground north-east of Sémecourt, with two magazines and two blindages. The ground in front was cleared of trees and other obstructions throughout the range of these guns.

The Hessian pioneer company was employed in making military roads through the wood of Silvange, near Pierrevillers, and in preparing a rallying position near Silvange, by making shelter trenches and gun emplacements, and clearing the ground in front. They also removed an exceedingly strong abattis which had been made by the French between Malancourt and Rombas (apparently with the view of checking the turning movement which won the battle of Gravelotte, although their right wing was not given a sufficient extension to enable them to utilise this defence).

Early in September, the Saxon pioneers commenced to build barracks for the infantry, and on the 5th of the month, to prepare a rallying position in rear of Amelange. At the same time the 10-gun battery north-east of Sémecourt was secured in front by a flanked abattis; the walls of the churchyard at Sémecourt were strengthened by an earthen breastwork banked up against them outside. More gun emplacements were also made between Fêves and the 10-gun battery.

When the French made a small sortie on this front on the 27th September in search of food, they were unable to continue their advance when they came under the fire of the batteries on the north-east of Fêves and Sémecourt, and in the evening, the Germans had re-occupied all their posts which had been driven in. But in consequence of this sortie, the number of batteries was still further increased, and many additional works were commenced on the left wing. These works were interrupted by the movements in the investing corps ordered at this time, which included the relief of the Xth corps by the IIIrd Reserve Division on the 1st October. Previously to this change, the pioneers of the Xth Corps commenced the repair of the railway line, Maizières-Uckange, and the branch Hagondange-Mayeuvre. The demolitions near Richemont were first made good, and an engine, found at Mayeuvre, which had been injured by the French, was repaired.

On the 1st October, the telegraph line having been restored, the regular service of the railway, Metz-Thionville, was recommenced, pioneers acting as drivers, and thus the connection between the

* These are nearly equivalent to our 40-pounders.

German troops investing Thionville with the Army of Investment of Metz was immensely facilitated.

After the French sortie of the 1st and 2nd October, in which they gained possession of Ladonchamps, the IIIrd Reserve Division, who had just taken over the position from the Xth Corps, cut all the main roads, as well as the railway leading out of Metz, and obstructed them by abattis.

Some walls in St. Remy were also thrown down to give a better range to the rifles of the men occupying the shelter trenches in rear.

Obstacles such as wire entanglements, trous-de-loups, pickets, &c., were also accumulated in front of the fortified points in the line.

During the night of the 8th October, after the last great sortie, the 2nd pioneer company of the Xth Corps aided by a working party of 400 infantry, prepared a rallying position north of Les Tapes, consisting of 12 gun pits and a line of shelter trenches. The gorges of these two posts were at the same time thrown open by the IIIrd garrison pioneer company. On the 8th, 9th, and 10th October, three redoubts were traced out to strengthen the line from Sémecourt to Amelange, each intended for six guns and a garrison of one or two companies of infantry. The working party employed daily on these redoubts, commencing on the 10th October, consisted of two pioneer companies and 1,000 infantry, in two reliefs; a third pioneer company was employed in preparing timber for the necessary bomb-proofs at the saw-mill at Richemont.

The first redoubt undertaken was near Maizières. Its perimeter was 220 meters. The ditch was only 4½ feet deep (probably because water was reached at that depth). It had barbettes for nine guns, four bomb-proofs, each having a floor space of about 180 square feet, powder magazines, and a traverse on the capital. It was completed in eight days. On the 14th October, the second redoubt was commenced a little to the west of the Metz-Thionville railway, and on the 18th, the third, south-east of Amelange. They were both similar in all respects to the first redoubt, and were completed in the same time, the third being just finished at the date of the capitulation.

To recapitulate briefly the defensive arrangements in this position. The outposts and first line were about 2,000 paces from the most advanced French artillery. Experience proved that to drive the outposts from this line, the enemy must expend much time and ammunition, and suffer heavy loss. At about the same distance in rear of this, was the main position, where an attack in force was to be met, and which was accordingly made excessively strong. Its strength lay not only in the obstacles prepared in front of it, the cover and good communications made for the defenders, and the numerous artillery, both field and garrison, placed in battery in it; but also from its retired situation, which exposed an enemy advancing against it to attacks on their left flank, and to heavy artillery fire on both flanks. Finally, about a mile still farther to the rear was a very strong rallying position following the line Marange, Silvange, Maizières, Hauconcourt.

The following abstracts of the dispositions for occupying the posi-

tions on the north and north-east of Metz, as they existed about the middle of October, are of value, showing, as they do, how the troops were partially billeted in villages in rear of their lines. This gave them rest and shelter, while the time necessarily to be expended by the French in overcoming the resistance of the outpost lines would be sufficient to enable them to march to the main positions, and occupy them before they could be attacked. In the abstract of the position occu-

Corps.	Disposition.	Strength. Battalions.	Squadrons.	Guns.	Pioneer companies.	Outpost line.	Main position.
Xth Army Corps and 3rd Reserve Division. N.B. A part of the 3rd Reserve Division was detached to Thionville.	Xth Corps	25	8	94	3	Extent on the left bank of the Moselle, 7,000 paces, viz., from Point-du-Jour, by the copse north of the Wood of Woippy, S. Catherine, Bellevue, St. Remy, Grandes Tapes, to the Moselle, opposite the Mill, above Olgy.	Extent on the left bank of the Moselle, 7,000 paces, viz., from Fêves by Sémecourt, Maizières, and Amelange to the Moselle. The position in the valley was commanded by the heights on either side, and was strengthened by three redoubts.
	3rd Reserve Division	13	8	36	1		
	Total	38	16	130	4		
	On the left bank of Moselle, 19th Infantry Division, and 3rd Reserve Division.						
	Viz., in front line ..	17	2	60	..		
	Within 1½ mile	4	..	..	..		
	„ 2½ miles ...	3	8	..	..		
	„ 4¾ „ ...	..	2	..	..		
	„ 7¼ „ ...	1	..	..	..		
	Total	25	12	60	..		
	On the right bank of Moselle, 20th Infantry Division and 1 Battalion of 3rd Reserve Division.					Extent on the right bank, 4,000 paces, viz., in front of Malroy, through Rupigny and Vany to Villers, l'Orme, where it joined the outpost line of the 1st Army Corps.	Extent on the right bank, 4,000 paces. It was strengthened by the fortified villages of Malroy and Charly, the Wood of Failly, and numerous batteries. Connection between the positions on the right and left banks was secured by four bridges, viz., 1 at Argancy, 2 at Hauconcourt, and 1 at Talange.
	Viz., in front line ..	12	..	24	..		
	Within 1¼ mile	..	4	..	..		
	„ 4¾ miles ...	1	..	..	..		
	Total	13	4	24	..		
	Corps Artillery.						
	In position at Argancy and Olgy	..	..	18	..		
	Within 1¼ mile	..	..	18	..		
	Within 1¼ mile of Malroy-Charly	..	..	36	..		

pied by the VIIth Corps at this time, which adjoined that of the Ist Corps on its left, and extended to Ars Laquenexy, we are informed

Corps.	Disposition.	Strength: Battalions.	Squadrons.	Guns.	Pioneer companies.	Outpost line.	Main position.
		25	8	84	3		
1st Army Corps.	*Right Wing, 1st Infantry Division.*					Extent of line, 5,000 paces. The outposts joined those of the Xth Corps north of Villers-l'Orme, the line then crossed the valley of Nouilly, between that village and those of Servigny and Noisseville, and continued on until it crossed the Saarlouis road, a little to the east of Lauvallier, which village was not occupied.	Extent of the position, 5,500 paces. It included the villages of Failly, Poixe, Servigny, Noisseville, and La Brasserie, which were all fortified. In advance of, and between them, numerous shelter trenches and emplacements for guns were made. A rallying position was prepared in rear, and three redoubts were commenced in the main position to strengthen it; but they were still incomplete at the date of the capitulation.
	In front line	9	1	..	..		
	Within 1½ mile	3	..	24	..		
	„ 3¾ miles	1	2	..	..		
	„ 4¾ „	..	1	..	..		
		13	4	24	..		
	Left Wing, 2nd Infantry Division.						
	In front line	3	..	..	..		
	Within 1½ miles	6	..	12	..		
	„ 2¼ „	3	..	12	..		
	„ 4¾ „	..	2	..	..		
	„ 6 „	..	2	..	..		
		12	4	24	..		
	Corps Artillery.						
	Within 2¼ miles	..	..	36	..		
	2nd Cavalry Brigade of 1st Cavalry Division attached to 1st Corps.						
	If ordered to concentrate at St. Barbe—						
	Within 2¼ miles	..	4	..	..		
	„ 4¾ „	..	8	..	..		
		..	12	..	..		
	If ordered to concentrate at Vigy—						
	On the spot	..	4	..	..		
	Within 2¼ miles	..	4	..	..		
	„ 3½ „	..	4	..	..		
		..	12	..	..		

that the two infantry divisions of the corps changed positions every eight days, one being on duty, the other in reserve. The division on duty had always 10 battalions, $1\frac{1}{2}$ squadrons, and a battery in the front line; the remainder were billeted within $1\frac{1}{4}$ to $2\frac{1}{2}$ miles in rear. The extent of the position was about 5,000 paces, so that there were always two men to the pace on duty.

In the concluding remarks on this investment, it is noticed that there was a want of uniformity of system in fortifying the different positions, and that occasionally they seemed somewhat disconnected.

These slight defects resulted from the principle that the full responsibility of the defences of each section should be thrown on the Officer commanding it, and that therefore the independence of these commanders should be fettered as little as possible by special instructions. Thus the position occupied by each corps formed generally a connected whole, complete in itself; but always reckoning on the assistance of the adjoining corps, and, in reality, although these positions did not always appear to be connected, there were no weak points between them, because each corps was careful to secure its wings, and consequently the points of junction were made doubly strong.

The fortifications consisted generally of a first or outpost line, but slightly strengthened, sufficient to secure the advanced posts against small sorties of the enemy, or to delay him for a considerable time at the beginning of an action, but too weak to hold out against an attack in force. Behind these was the main position, carefully prepared for the most stubborn defence, and finally in most cases a rallying position in rear of all. Numerous covered ways were made to communicate with the advanced posts; shelter was also made for the picquets and supports, particularly when the localities were favourable for the purpose. The main body of the outposts, whenever it happened to be placed in advance of the main position, was protected by fortifications, in order to secure the retreat of the outposts, and to gain time for the occupation of the main position.

In fortifying the main positions, the following points were considered of chief importance:—

1st. As strong a fire as possible was obtained on the ground in front, particularly on the roads and defiles within effective range. This was secured by rifle fire from trenches, and by artillery fire from emplacements, each gun being placed by preference in a separate emplacement, in order to divide the enemy's fire. Great *stress was laid on clearing the ground in front of the position* ("freimachen des gesichtsfeldes"). In doing this, large woods were felled, the clearings being extended farther and farther by degrees.

2nd. The close attack was rendered difficult by obstacles of all sorts. Abattis were most largely used on account of the unlimited supply of material suitable for the purpose, obtained by clearing the ground in front.

3rd. The intervals between the natural or artificial strong points were closed, in open ground suitable for manœuvring, by flanked shelter trenches, in close country, by impenetrable abattis, as far as possible under fire.

4th. The communications throughout each position, and between it and the neighbouring positions, were improved by the formation of numerous military roads, and the bridging of rivers and streams.

5th. Roads for offensive action were specially prepared in suitable positions, by leaving openings in the lines, or making the trenches so shallow that troops could pass over them. Traversed passages were also prepared for smaller sorties in other places.

6th. A complete system of field telegraphs connected the head quarters of all the different sections with one another, and with the general head-quarters, and ample arrangements were made for giving the alarm and assembling the troops billetted in rear by means of signals. The enemy's movements were carefully observed by day and by night from the various observatories, in order that the alarm might always be given in good time, and preparations made to meet an attack.

Captain Goetze gathers the following lessons from the "rich experience gained in the war of investment around Metz:"—

1. It is extremely difficult for an Army invested in a great entrenched camp to break out after the investing Army has had sufficient time to fortify its positions, and supposing that good use has been made of this time, unless indeed a relieving Army comes to the assistance of the fortress. In the first period of the investment, on the other hand, the Army which is surrounded has great chances in its favour, if the arrangements be judicious; but it can only succeed when the attack is a surprise, and when the enemy's attention is distracted at the same time by sorties on different fronts.

2. The commander of the troops defending the entrenched camp cannot make good use of the advantages of his position, unless his troops have good protection against the weather. Hence it is incumbent on him to take the most careful precautions on this head before bringing his Army within the fortified lines, if he is liable to an attack or an investment.

3. The regular siege of an entrenched camp, fortified in accordance with the principles of modern warfare, and defended by a sufficient number of good troops, is so excessively difficult, and requires such a considerable artillery *matériel*, that probably in most cases an investment and starving out of the garrison will lead to the result as quickly, and with a much smaller expenditure of men and materials of war. This consideration should induce the commanders of such entrenched camps to lay in, in good time, an ample stock of provisions for both the Army and the inhabitants. In exposed frontier fortresses, the preparation of great magazines, always to be kept full, even in time of peace, seems an absolute necessity.

4. On the part of the investing Army, the following rules should be observed:—

a. The whole range of investment should be divided into definite sections of moderate size. For each of these a special engineer and artillery staff should be appointed, to remain in office during the whole period of the investment. To this staff should be entrusted the tracing and carrying out of the works of defence,

in accordance with the general instructions from the Commander of the Army of Investment, and more special directions from the general commanding the particular section. The Army Corps or divisions appointed to defend each particular section should not be moved from them, if it can be possibly avoided. Should a stronger defence of any part of the line appear necessary, it should be effected, not by shifting the position of the troops in the whole investing line, but by moving up troops held in reserve to the threatened point. The troops would then have more pleasure and satisfaction in working on the defences of the positions entrusted to them, because they would know that in those positions they would have to fight throughout the whole duration of the investment. Far more care would also be bestowed on providing comfortable shelter for the men.

b. The fortification of the positions should be carried out on a connected and well-considered plan. They should be commenced at the very outset of the investment, and should be pressed forward with the greatest energy, employing every available man on the works, and strengthening the defences day by day.

c. Whenever the features of the ground make it possible to do so, the main positions for the defence should be selected, so as to be beyond the effective range of the artillery of the fortress, viz., from 4,000 to 5,000 yards from the detached forts.* In front of these positions the advanced posts should only be pushed forward as far as is absolutely necessary, and on principle they should never allow themselves to be involved in serious fighting. In the outpost duty a good system of patrolling is especially important, and to this should be added most careful observation from high, well-placed observatories connected with the head quarters of the different sections, by electric telegraph.

The main position should be thoroughly prepared for the most obstinate defence, and must be provided with a sufficient number of strong tactical points, made as secure as possible against assault. In addition to the main position which can and must be defended for a long time against an attack of very superior forces, it appears generally advisable to have a rallying position, which latter will require only slight defences, more especially long lines of shelter trenches, because here sufficiently large bodies of troops can be collected, who should energetically assume the offensive, attacking the flanks of the advancing enemy.

d. In the main position of each Army Corps, protection against the weather must be provided for a reserve, always prepared for action, of at least 1 or 2 battalions, a squadron, and a battery. These troops should be placed in houses or barracks at important junctions of roads, and the construction of these barracks

* This distance seems under-estimated. The villages occupied in the positions on the north-east of Metz were about 4,500 yards from Fort St. Julien, and Captain Goetze states elsewhere that the French fire was so effective, that had it been maintained with vigour, those villages must have been abandoned.

should be undertaken at the very commencement of the investment, and pressed forward with all speed, regardless of expense, the preservation of the health of the troops being of primary importance.

e. The necessary bridges over any large streams which may intersect the investing line should be constructed at the beginning of the investment, and well secured against the action of floods or ice. If possible, they should be made by contract, the engineers being more profitably employed at this time in fortifying the positions. The pontoon trains should not be used for such bridges if it can be avoided, as they are likely to be of use to the Army in the field.

f. In many cases, a simply constructed cincture railway may be of great value to the investing Army.

g. As regards the details of defences, a shelter-trench of slight profile, enlarged by degrees into a sort of "parallel," and which, by means of obstacles in front, can be made secure against assault, is to be preferred to any description of enclosed works. These latter require an excessive amount of labour, especially if the soil be unfavourable and the weather bad, and this labour is seldom available. Enclosed works, moreover, afford no protection worth naming against the accurate fire of modern artillery, if they are not traversed and provided with ample bombproofs. The larger the redoubts, the more exposed is the garrison to curved fire. The garrisons of such works seem indeed almost powerless, if only attacked by swarms of riflemen.

Under no circumstances should field artillery be enclosed in field redoubts; but the guns should be placed further to the rear in traversed emplacements, the garrisons of the redoubts acting as the "special escorts" of the artillery.

If light garrison guns (9 and 12 c.m.)* are disposable for the defence of the position, they should be placed in special batteries, having bombproofs under their traverses, and made secure against assault.

The protection of these batteries must be ensured by infantry in shelter trenches in advance of them, and also by special reserves sheltered near at hand.

I must here make a few observations in connection with these remarks on investing lines.

In Colonel Hamley's "Operations of War," it is shown, that in ordinary cases it will now be advisable for troops acting on the defensive to make their stand on their first line without any thought of retiring to a second position, because the losses in retreat will probably be even heavier than those experienced by the enemy in attacking. The object of the defence then will ordinarily be to select a strong line, and to defend it *à outrance*, bringing up supports and reserves to the front rather than retiring upon them. The necessity of outposts does not complicate the question seriously in ordinary cases when they are not

* Somewhat inferior to our 20-pounder and 40-pounder rifled guns.

Journal R.U.S. Institution. Vol. 18.

N. D. de Bonnetville
Bois de St Gervais
Fontaine sous Préaux
Mt St Aignan
St Martin
FORET
DE
ROUMARE
Deville
Bois Guillaume
ROUEN
P.F
Sein Inf
Canteleu
le Pt Quevilly
Blosseville-Bon servteurs
Dieppedalle
le Gd Quevilly
Sotteville-lès-Rouen
Quatre Mares
Ainiville-la-Ma-Vie
SEINE
le Pt Couronne
FORET
St Etienne-du-Rouvray
Belbeuf
Chemin
la Chapelle Chau
Petit Caux
Oissel-sur-Seine
Gouy
le Port St Ouen

from Bourgachard
from Bourgtheroulde
from Bourgtheroulde
Sahurs
Trénquerville
Hautot
COURONNE
LA BOUILLE
Moulineaux
Romilly
Romilly
DE LA LONDE
Orival
la Londe
Nubin
ELBEUF
Bosroger
St. Ouen du Tilleul
Thuit
Thuit
Thuit
Scale 1/80000
0 1/2 1/2 3/4 1
2
Redoubts projected but not made
Houses prepared for defence
Barricades

le Pt Couronne
FORET
St Etienne
Belbeuf
Cellov
Ducarville
St Au
Chemin
Passage St Adrien
St Cresp
du Becquet
La Chapelle
Chau
ROUVRAY
Gouy
Le Port St Ouen
Petit Enfer
Oissel
sur Seine
Pt Essart
Ge Essart
Clos Gaillard
Port d'Oissel
Belle Fosse
Tourville
Bas Cleon
Cleon
Pt Cleon
Pont de la Ville
Freneuse
SEINE FL
Ile de Criquebeuf
Criquebeuf
sur Seine
Bonport
PONT DE L'ARCHE
Martot
Caudebec
Pont de la Ville
la Haliine
la Barclequé
St Pierre
les Elbeuf
Les Authieux
Boisguillaume
Sotteville
sous le Val
Fer
Louville
le Fard
Stanford's Geog.l Estab.t Charing Cross, London
2
3
4
English Statute Miles.
cades. XXXXX Abattis. T.S. Torpedo obstruction. S.S. Ship obstruction. B. Battery. Shelter trench. Military Road

intended to fight; but rather to keep spies and reconnoitrers at a distance, and to watch and give timely notice of the enemy's approach. When armies are operating against one another in the field, should the outposts of the one be attacked, it is ordinarily by the advanced guard of the other, advancing on a narrow front, and therefore requiring some time to deploy and to reconnoitre before attacking. A small body of men on outpost duty, if skilfully handled, may in such cases deceive and delay an enemy for a considerable time, and when the deception is discovered, and they are "driven in" by superior numbers, they may generally get back to their supports with small loss, because their numbers are few and they can retreat rapidly, in skirmishing order, over ground which they know, while the enemy has to feel his way.

In investments, however, the case is different. In order to give necessary repose to the main body of the investing Army, it is evidently essential to have a comparatively strong outpost line always ready for action, and prepared to hold their ground sufficiently long to allow the main body to collect. The outposts are, in fact, an advanced guard, separated from the main body by a much smaller distance than is usual, because the investing lines must be closed in as much as possible in order to avoid undue extension, and to deprive the enemy of the use of the ground surrounding his works. Hence they are bound to maintain their ground longer and more obstinately than in ordinary cases, in order to gain sufficient time for the occupation of the main position. Moreover, the enemy has great facilities for rapidly developing large forces for an attack on account of the peculiar advantages of his position, his nearness to the investing outposts, and his previous knowledge of the ground, which makes reconnaissance unnecessary. Hence the troops occupying the outpost line of the investment, are always liable to be greatly outnumbered quite at the beginning of an attack.

Supposing this to be the case, that they have suffered heavy losses, and are becoming somewhat demoralised, what is to be done? Should they retreat to the main position? or should support be sent to them?

Were it possible, it clearly would be best to support them by fresh troops, and never to allow the enemy to set foot within the outpost line; but there is a reason which usually forbids the massing of men so near the fortress, viz., the action of the heavy artillery of the defence. This is not formidable when only a thin line of troops is exposed to it, but on considerable bodies it has great effect. Under the circumstances of the case, retreat therefore becomes a necessity, and the investing Army ought to make skilful preparations to enable the troops on outpost duty to get back to the main position without suffering severely. Probably trenches traced "en zigzag," like siege approaches, and enfiladed from the main position, will best answer this purpose, wherever natural cover such as fences, walls, belts of wood, or inequalities of ground do not afford the required protection.

We now pass on to the operations near Rouen. After the fall of Metz, the Ist Army advanced on Rouen on the 1st December, 1870. On its approach, the French abandoned the line of field-works they had prepared outside the city, in which they left 29 guns.

Rouen was now a base for further operations, and its security became an important question. The Engineer Staff, with the Commanding Officers of Artillery, were ordered to make a reconnaissance and to report on the best means of defending the city with a small garrison, more especially as a bridge head.

They reported that the environs of the town were naturally divided into two parts by the Seine, here 160 metres broad. On the right bank, the ground is hilly and broken by deep valleys. For its defence they considered ten redoubts would be required, placed on the arc of a circle having a radius of about 5,000 paces, measured from the middle of the city, and spaced at about 2,000 paces from one another. On the left bank the ground is lower and more level in character, and the suburbs stretch out far into the country; it was considered necessary to defend the outer line of these suburbs by two redoubts, three large buildings made defensible, and a battery.

The number of troops, &c., required to hold Rouen, was calculated as follows:—

	Battalions.	Guns.
On the right bank—Garrisons for 10 redoubts (one company for each), with "Special Reserves" (or troops immediately supporting them)	11	48
General Reserve	6	..
On the left bank—Garrisons of the works with "Special Reserves"	6	24
General Reserve	3	..
Reserve Artillery	..	18
Total	26	90

The extent of the line to be defended, was about ten miles on the right bank, and about six miles on the left bank of the Seine. It is interesting to note that about one battalion to the mile, with half a battalion in reserve, supported by about one battery of field guns to the mile (of which three batteries were reserved for concentration at any point), was considered by the German Staff as a normal garrison for an entrenched position.

The redoubts were intended to be well provided with bomb-proofs, and to have such obstacles in the ditches as would render them secure against assault.

This project was, however, not approved by the Generals Schwartz and Bichler, who considered that it would not be advisable to attempt to hold Rouen with a small garrison, because the force would be divided by the river, and intercommunication much obstructed by houses and enclosures, while the hostile population would be a constant source of anxiety. That it would be much better, in case of an attack, to move outside the town, and, freed from its trammels, to meet the enemy in the field. Holding these views, they considered that a concentration in Rouen was to be avoided. It seemed also desirable to disperse the newly-formed French troops as soon as possible, and therefore that the Army should not be tied to one point. These considerations led to the abandonment of the proposed scheme for defence.

A field pioneer company was charged with the defences of the Seine. They impressed a steamboat which the pioneers worked, and made a reconnaissance of the river with the view of forming a barrier against gunboats. Duclair, about 26 miles below Rouen by river (only 10 by road), where a bluff gave a favourable position for a battery to defend the obstruction was the position at first selected, and there being no French vessels available, a number of English vessels were requisitioned to be sunk in the channel. Subsequently the site for the obstruction was fixed at a point a little nearer Rouen, about 1,000 paces below Lafontaine, where the river is about 290 yards wide. Here a battery was built, and shelter trenches were made to flank the obstruction. It consisted of nine ships sunk in the channel. Their masts, which were above water, were connected by heavy floating booms, and a row of 19 torpedoes (to be ignited by contact, and containing each 75 lbs. of powder), was placed below the obstruction. They were spaced at intervals of about 40 feet, and were 8 feet below high water, and 1½ feet below low water-level. The river is about 30 feet deep at low water; the torpedoes were, therefore, moored and floated some 28 feet above the bed of the river. Another group of torpedoes was placed at Le Trait, about 15 miles lower down the river (about 5 miles distant by road), and a battery and shelter trenches for infantry were made to guard it. Two steamers were also used to patrol the river and watch the movements of the enemy. Ice in the river so interfered with the torpedo operations that they were not quite completed before the armistice. It is interesting to note that these torpedoes were safely removed by the Germans in February.

About the middle of December, the flying columns sent out in different directions from Rouen became aware that the French were gathering strong forces on the left bank of the Seine, while they also menaced Rouen from the north-west.

It was, therefore, considered necessary to destroy the bridges over the Seine, south of Rouen, near Orival and Elbœuf, and to fortify a defensive position across the neck of the peninsula formed by the loop of the Seine at this point. The railway bridge near Oissel, in rear of this position, was at the same time ordered to be made passable for all arms. Above Rouen, the bridges at Pont-de-l'Arche and Le Manoir were guarded, all others were destroyed. Two field pioneer companies were charged with these works. The position to be defended between Grande Couronne and La Roquette, was about 7,000 paces in extent; of this, about 2,000 paces had been strongly entrenched by the French. The right of the line rested on the Seine, and the swampy nature of the ground made it difficult to attack. The road to Elbœuf was enfiladed by a strong battery. Thence the line was carried for about 2,000 paces through the wood of Rouvray, where a broad belt was felled, and the trees formed into an impassable obstacle.

The centre of the position was strengthened by the entrenched villages of Grand and Petit Essart with the Château of Sason forming a sort of ravelin in front of them. The left rested on the steep banks of the Seine, here 150 feet high, and was secured by abattis flanked by shelter trenches and by the village of La Roquette, which was made

defensible. These works, commenced by a part of the pioneers on the 21st December, were carried out mainly by strong working parties of infantry, the critical nature of the situation rendering it necessary to employ every available man on the works, which were completed on the 3rd January. It was deemed highly important to destroy the bridges at Elbœuf, especially on account of the difficulty of making pontoon bridges at this time of year owing to the floating ice in the river. All the pioneers that could be spared from the entrenchments were, therefore, employed in mining these three bridges.

The suspension bridge was first attacked. The chains were filed through in three-quarters of an hour, and a whole span, 100 metres wide, fell. Another similar span was left intact. The next bridge assailed was that which carries the Great Chaussée between Elbœuf and St. Aubin. It had five spans of from 120 to 150 feet. The piers of this bridge were of sandstone encased in $1\frac{1}{2}$-inch iron plates. The road was carried on iron girders 10 feet deep. Shafts were sunk in two of the piers, and altogether about 250 lbs. of gunpowder were lodged in them. The mines were ignited simultaneously by Bickford's fuse, and the result was the destruction of two 150-feet spans. One of these was completely thrown into the river and sunk. The other remained resting on a pier at one end, while the other, partially supported, hung about $1\frac{1}{2}$ feet above the river.*

Only the railway bridge now remained at Pont-du-Gravier. It was 1,000 feet in length in seven spans of from 130 to 150 feet, and it carried a double line of rails. The piers were of squared granite encased in $1\frac{1}{2}$-inch to $1\frac{5}{8}$-inch iron plates, secured together by massive iron rings, and the iron girders were more than 10 feet in depth. For the demolition of this bridge, there were now only 2 cwt. of gunpowder available, and it was impossible to obtain more quickly. There was, also, a scarcity of time, tools, and materials. Owing to pressing orders to that effect, however, an attempt was made to destroy the bridge on the 23rd December; but it was, as was expected, a complete failure. The preparation of new mines was immediately commenced and pressed forwards day and night, and 240 lbs. of gunpowder (all that could be obtained) were lodged in two chambers. The explosion only had the effect of destroying the top of a pier, and allowing the girders to sink about 3 feet. The bridge, however, remained quite passable. More powder was now demanded, and the work recommenced on the 25th December. Attempts to break away the granite by hammers, or by lighting fires on the stone and suddenly cooling with water both proved unavailing. The mining was, therefore, recommenced, but it progressed very slowly, owing to the want of proper tools, the hardness of the stone, and the exhaustion of the men. On the 30th December, the mines were not finished, but the enemy had appeared and endeavoured to stop the work by the fire of artillery and small arms. It was, however, carried on, and another attempt at demolition was made.

* It is not evident how the demolition of *two piers* only injured two spans, unless one of them was an abutment pier, which was not a judicious arrangement. The demolition, however, was amply sufficient.

The bridge was injured considerably, but still remained passable. Two smaller mines fired towards evening produced little effect. More powder was procured, and fresh mines were prepared, and at length, on the 31st December, the demolition of about 330 feet of the bridge was fully accomplished, after the work had been carried on for eight days, and 15 cwt. of powder had been expended.

Captain Goetze remarks on this occasion, and on many others during the course of his narrative, that the quantity of gunpowder supplied to the field pioneer companies was quite insufficient. As each company is supposed to carry 500 lbs. in its "powder waggon," this is an important point to note. We may remark that, in most cases, gun-cotton is, weight for weight, at least three times as powerful as gunpowder, and that if this explosive be substituted for the other, the 500 lbs. would probably be sufficient. Our experience in the use of this material is still, however, imperfect—experiments are needed to discover the best mode of applying it to the demolition of iron bridges. It seems probable that the iron girders themselves may be shattered by gun-cotton, and that the excessive labour of mining and destroying the piers which support them may thus be avoided.

As the enemy approached Rouen in great force, the fortified position which had been prepared seemed likely to be of great value. The French, however, did not attack, and a small sortie made on the right of the German line was successful. They accordingly advanced out of their fortifications and drove the French out of a sort of investing line which they had begun to fortify, about three miles south-west of the German position. Here the Germans again fortified themselves, sending out, however, a flying column to follow the retreating French towards Honfleur, and destroying the railway from Rouen to Brionne. They pushed out advanced guards to Bourgachard and Bourgtherould, about five miles in advance of their new position, and situated on the chaussées leading into it. These places were also fortified. This constant use of field fortification by the Germans, while at the same time they were always ready to assume boldly the offensive when opportunity offered, is most instructive, and shows how thoroughly these troops understood their special business, which was to guard and hold firmly the roads and railroads by means of which relief might be sent to Paris, while, at the same time, the newly raised troops which might attempt this relief, were to be attacked and dispersed.

We have now seen what an extensive use was made of field-engineering by the German Armies, and the value of this branch of military art has been so clearly shown by the few examples selected, that it only remains for us briefly to deduce such lessons as seem applicable to ourselves with reference to that department of field-engineering of which I am treating. The principal points for decision are the following:—

a. Under what circumstances should field works be used?
b. What should be the character of the works?
c. Who should do the work?
d. How should their tools be carried?
a. The circumstances under which field works should be used are

broadly, two—in defence and in attack. In the former, always, if possible; in the latter, only in a subordinate way, to secure tactical points when they have been won. But there are cases intermediate between these, such as defence with intention to attack, or attack with precautions against counter-attack, in each of which field works should also be used, provided that they are designed with skill, so as not to hamper the movements of the troops.

b. To answer the second question fully would require more space than can here be accorded to it; but we have seen that the general result of the experience of the war of 1870-71 has been to discredit regular field works, and to show the advantage of shelter trenches, and a clear field for fire. Not that redoubts have lost their value entirely; there are cases in which such works may still be of great value; but to be tenable against a modern artillery attack, they must be provided with bombproof shelter, and this entails much labour. Moreover the shelter trench gives generally the best position for infantry to develop the full power of their weapon. The redoubt accorded best with the close formations of former times, the shelter trench lends itself better to the fire tactics of the present day. We may take it for granted, then, that the form that modern field works will generally assume will be—1st, a clearing of the ground over which an enemy must advance, so that he may be fully exposed to view; 2nd, providing such shelter, in the form of slight trenches, as may be necessary to supplement shelter naturally existing. In this country, or wherever fields are enclosed by substantial fences, they will give in most, all the cover necessary to a defending force; but unfortunately they also screen the attack, and their removal involves much labour. In open ground, the supports and reserves must often have shelter provided for them, and generally it will be found best to make this shelter by means of several short trenches, arranged "in column," rather than by one or more longer trenches "in line," in order that the troops so sheltered may be in hand, which cannot be the case if they are in extended formation.

Of these two operations, depriving the enemy of cover in his advance, and providing cover for one's own troops, the former is undoubtedly the most important. Soldiers lying down in extended order are a difficult mark to hit, even should they have no cover, natural or artificial, and they have an immense advantage over enemies obliged to move towards them, provided that these latter cannot find cover. Clearing away cover in front of a position should therefore be invariably the first consideration. This being done to a sufficient distance, attention should next be turned to screening the defenders, and to improving communications. When walls and buildings are to be defended, loopholing is the first requisite. Other accessories to the defence may be supplied afterwards, should time and means allow.

I have lately had an opportunity of conversing with General McClellan on some of the operations of the late American war, and from him I learnt how the extensive slashings or clearings in the forests, of which we have all heard, and which were so essential in that wooded country, were made. He said that, practically, they always employed special regiments in such work: regiments which had been

raised in the far west, and every man in which had been accustomed from his boyhood to wield an axe; these regiments formed, in fact, their pioneers, and were provided with axes in sufficient numbers to enable them to do the work required.

The necessity of clearing away cover to give free scope for the employment of firearms to advantage, has now become so very pressing, that it behoves us to provide carefully for this branch of field-engineering, for although we may not always have to fight in pine woods, as was ordinarily the case in America, nor yet in African forests, yet even in England, should we ever unfortunately be called on to defend our native soil, hedge rows and small woods mask the movements of troops to such an extent, and give such advantages to the attack, that we shall find it most essential to have a plentiful supply of good cutting tools, and of men skilled in the use of them.

In our present equipment, there is a good supply of picks and shovels, but a comparatively small proportion of axes and cutting tools. Were we to be again called on to conduct a war in an open country, such as the Crimea, this would doubtless be right, and in our peace-manœuvres they are the only tools that can be used, because a trench or a gunpit can be made and filled in again, with but slight injury to property, whilst the felling of trees and demolishing hedge-rows would entail such disfiguring of the country, and destruction of property, and such consequent heavy charges for compensation, that such work would evidently be impossible in peace. All that can be done is to have cutting tools selected and packed for transport, and to train men to use them. The only available field for such training seems to be in the Royal forests, and although doubtless some timber would be wasted in the instruction of men unaccustomed to the use of the axe, yet the annual employment of a detachment of Royal Engineers and of infantry pioneers in the work of thinning the Royal woods, would give such valuable instruction, that the waste of timber would be amply repaid by the power gained for the defence of a wooded country. This practice would lead also to the perfection of our equipment in the matter of cutting tools, the authorised pattern of our military felling axe, for instance, being universally acknowledged to be far inferior to that ordinarily used in America, more particularly in the shape of the handle. The American curved handle, being far more convenient to use than our straight handle, it would be well, too, to enlist in the engineers, a proportion of skilled woodmen.

A new agent, which may advantageously be employed in felling trees in some cases, has recently been discovered. Gun-cotton, when detonated in contact with any resisting substance, produces an extraordinary local effect, and this property has been experimentally applied to felling trees, with very satisfactory results. The gun-cotton may be placed in the form of a necklace round the tree, or it may be inserted in a hole bored into the tree with an auger. In the former arrangement our experience seems to show that about 1 lb. per foot in girth, is sufficient to fell the strongest trees, but, as might be expected, the gun-cotton produces a far better effect when inserted in an auger hole; about $\frac{1}{10}$th of the quantity required in the former case being sufficient. Gun-cotton is

inapplicable to the felling of trees for commercial purposes, because in whatever way it may be used, the timber is liable to be split and torn to a great extent. Neither is this agent likely to supersede the axe when any considerable amount of felling has to be performed, because time would be lost in moving the men out of the way to allow of successive explosions, and this specially if the more economical plan were adopted of lodging the gun-cotton in auger holes, in which case splinters fly to considerable distances; moreover, the detonating fuses which must be used, introduce an element of danger, which would probably produce accidents in a large operation when many men were employed. But for rapidly felling a few large trees to block a road, or to open a field of fire for artillery, there can be no doubt that this mode of operation will be found of great value.

I have alluded to redoubts as being less generally useful in the present day than they were formerly, and that, if they are made, it is essential that the garrison should be provided with ample bombproof cover. We have also seen that artillery should not be placed in redoubts, if it can be avoided, but rather in batteries farther to the rear than the redoubts, and protected from the attack of hostile infantry by the garrisons of the redoubts. Before leaving this subject, I must enter a protest against the *pons asinorum* of military students: the square redoubt puzzle. The proper size for a square redoubt, to contain a given garrison of infantry and artillery, has been a stock puzzle-question for examiners in fortification for many years past. Macaulay, of time-honoured memory, gave certain solutions to the question, involving pretty little sums in equations, which, taken originally from French sources, have been perpetuated in nearly all our works on fortification.

But not only are these square-redoubt-puzzles utterly useless in a military point of view, but the data supplied for working them out, are absolutely erroneous, for, in the first place, the interior space, supposed to be available for the troops off duty to bivouac in, is always considered to be necessarily diminished by the slope of the banquette, which, in reality, is the very choicest bed to be found within the work. The space occupied by the gun is also excluded, although it is here that the gun detachment ought to lie down, both to be ready at a moment's notice, and also because the gun platform gives them a dry bed, and they can easily form a tent by hanging waterproof sheets, blankets, or great coats over the gun. Moreover an additional 600 square feet is said to be required for each gun over and above the space it occupies at the parapet. The object of this space has never been explained, nor can I imagine its use, because the magazine would naturally be made under the traverse, which is also allowed for, and projectiles should be in shell-recesses under the parapet. The perimeter of the work is the only real point of importance, and this ought always to be so proportioned as to be properly defended by a definite unit of command, such, for instance, as a company, two companies, or a wing. A redoubt for a smaller garrison than one company, would probably never be made; and even were the company only 80 strong, it will be found that the interior space is quite sufficient. The larger the garrison, the

more ample becomes the space included within the work; besides the bombproofs, which must be constructed if the work is to be held against artillery, give accommodation underneath the traverses.

I am not aware that throughout the whole of the operations in France during 1870—71, one square redoubt was made, although positions were entrenched to the extent of several hundred miles in the aggregate, and a great number of redoubts were constructed, more especially round Metz and Paris. The case rarely occurs that a work is equally liable to attack on all sides or that the site is quite regular, and even then a square would be a less suitable form than a hexagon.

For posts on a long line of communications or on a frontier line in an uncivilised country, square redoubts may perhaps occasionally be used, but generally under these circumstances, a block-house or a fortified village, would be better than an earthwork.

On the subject of bridge-heads, a few remarks appear to be necessary, because one notices in the operations of both the contending powers in the late war, that old ideas still retained their hold, and that the bridge-heads made, were not always well designed. The object of a bridge-head is two-fold, to secure the passage of the river for the defenders, and to prevent the enemy from using the bridge. Now the old-fashioned works, made close to the river, may have the latter effect; but they certainly will not have the former, if the enemy's artillery can be placed so as to see the bridge or the approaches to it within 3,000 yards range. Their fire will effectually seal up the bridge and stop any attempt to pass troops over it. It is therefore essential to keep the enemy's artillery out of range, and the works, unless they fulfil this requirement, are useless during daylight. A glance at the German bridge-head on the right bank of the Moselle at Hauconcourt, will explain my meaning. The works were evidently valueless for covering the passage of troops, had the French artillery attained the high ground overlooking the bridges, on the east bank of the Moselle.

As regards profiles, I am strongly of opinion that a shelter trench about 4 ft. wide and $1\frac{1}{4}$ ft. deep, the second stage of our authorised shelter trench, which can be made by untrained men 5 ft. apart in about half-an-hour, is that which should ordinarily be adopted. It gives comfortable shelter to a single rank of men with their officers and supernumeraries—a double rank, for which it was originally intended, would never, I presume, now be used. The first stage, only 2 ft. wide is too small, the cover it gives is insignificant, and the men are in a very cramped position. The separate trench for supernumeraries in rear of the front trench would thus be unnecessary, and as it gives very poor cover, having no parapet, the supernumeraries would not object to the omission.

It has been frequently observed that men behind a parapet, if they are exposed to a hot fire, shoot high and do little execution. The reason is plain. The head is the exposed part, and the natural tendency is to crouch low and get the head under cover, so that the butts go down and the muzzles go up, and the bullets go over the enemy's heads. To avoid this, it is most essential, whenever means

are available, to cover the defenders' heads by some such means as a log laid on the top of the parapet resting on sods, stones, &c., so as to have a sufficient space between it and the parapet for the men to see their enemies clearly, and to fire easily. This species of long loophole was used very generally during the last American war, and the instances in which the logs were struck by artillery fire were so rare, that no objection could be raised to the plan on this score.

For redoubts or works to withstand artillery fire, probably 12 ft. is thick enough to resist any guns that can be brought into the field, at the long ranges at which they are now used; but the curve of the trajectory is so great, that to give any cover to men behind a parapet, must have a relief of at least 9 or 10 ft., and this can only be obtained economically by using a trench in rear as well as the ditch in front. The trench system has always the disadvantage of collecting water in wet weather, an evil only to be met by careful drainage. The ditch, too, will be less formidable; but obstacles can generally be accumulated outside it without difficulty.

Artillery emplacements very generally would be made by the artillery themselves; but in some cases, as for instance when a position is being prepared for an Army to fall back into, the duty devolves on the engineers. The ordinary German gun-pit, although giving rather less cover than that adopted in our service, has the great advantage of affording a wide lateral range to the gun, which fires over the parapet instead of through an embrasure as with us. Should the enemy attack in a direction different from that which was expected, our gun-pit probably is useless, while the German pattern is always efficient. The German position battery, such as was used by the Austrians at Sadowa, appears also worthy of imitation, should time and means be available, especially when it may be desirable to place guns close together in order to obtain a powerful fire from a position of limited extent.

In selecting sites for batteries or gun emplacements, a gently falling glacis immediately in front of the guns, is no longer to be deemed advantageous as it used to be, or as it now is for infantry trenches. It is better that the ground should fall steeply in front of the guns, so that the enemy's projectiles which fall short may bury themselves, and that the infantry, in advance of the batteries may be less incommoded by the guns firing over their heads. Artillery fire directed from an elevated position searches better into hollows than if the guns were at a lower level, and at the comparatively long ranges at which artillery is now employed, the curve of the trajectory is inevitably so considerable, that the slight increase in the angle of descent of the projectiles caused by placing batteries on moderately high ground, need not be considered.

c. We come now to the question, who is to do the work? It has been established as a peace-drill in our Army that all infantry soldiers should learn to make shelter trenches—most valuable is this training—and I trust that it may not only be kept up but extended to other branches of field-engineering. We need never fear that our soldiers will be too thoroughly educated in all branches of military knowledge. In war, however, we must not expect that infantry soldiers

will often be able or prepared to carry into effect this part of their training. If we look to the experience of the Germans in the last war, we find that although an attempt was made to train a portion of the infantry as pioneers, and they actually were employed as such to a limited extent in the outset of the campaign, they soon lost their tools, and the men were either "expended" or it was found that they could not be spared from their battalions, who wanted every available fighting man to repair their heavy losses, and the work practically devolved on the engineers, who were however assisted in the greater operations, such as in the investments and sieges, by working parties of infantry. We know too, that even the First Napoleon, with all his energy and influence over his soldiers, was unable to get them to carry entrenching tools, or to dig. And the antipathy which the British soldier has always shown to being obliged to do trench-work is so well known, that we may as well accept the inevitable, and dismiss the idea that infantry soldiers are *ordinarily* to make field-works. It is an engineering operation, and it should devolve on the engineers. As their own proper work, they take a pride in performing it well, and being trained workmen they not only will do it better, but also much more quickly than untrained men, or men less accustomed to the work.

The only question is what proportion of engineers will be sufficient? Let us examine this point. A Prussian Army corps, consisting of 25,000 infantry, with cavalry and artillery, has three pioneer companies, or 600 pioneers (or engineers) attached to it. This gives the proportion of one engineer to 42 infantry. Our present organisation is four companies of engineers, each 120 strong, to an Army corps of 22,386 infantry, or one engineer to 46 infantry, a smaller proportion than obtains in the German Army. It is to be noted that in the German infantry, a much larger proportion of skilled workmen is to be found than in ours, owing to the different modes of enlistment in the two countries, and that during their last campaign the German engineers frequently had to call on the infantry for aid. Hence it would seem right that the proportion of engineers should be larger in our Army than in theirs. In 1866, our authorised Army organisation was one company of engineers to each division of 4,974 infantry. Since then, our normal division of infantry has been increased from 4,974 to 7,464; but still only one company of engineers is attached to it. Were two companies attached to each division or one to each brigade, our proportion would be about one engineer to 31 infantry. And when it is remembered that these men are available to be put into the fighting line, if necessary, and that both in our own service in India, and in the German Army during their last campaign, they have done good service in this capacity, this proportion will not be deemed excessive.

d. In regard, lastly, to the mode of carrying the tools, three methods may be employed; they may be in waggons, on pack animals, or carried by the men themselves.

In our service, a tool-waggon is supposed to accompany every infantry battalion. Our peace-manœuvres have shown us the inconvenience of this arrangement—waggons cannot follow infantry skirmishing over broken ground, and even when marching on roads, it is

objectionable to have waggons mixed up with infantry at the head of a column. Should they suddenly come under the enemy's artillery fire, confusion and a block on the road is the probable result. Pack animals are in some ways less objectionable. The chief difficulty in connection with them is, that so few tools are carried by an animal in this way; horses and mules and drivers are therefore unduly multiplied if *many* tools be carried on pack animals. In the Prussian Service, each engineer soldier carries a tool of some sort, in addition to those carried in the company waggons. This method has the sanction of extensive practical experience, nevertheless it is doubtful whether engineer soldiers carrying their arms and accoutrements with tools superadded, can be fresh enough at the end of a march to perform the hard work they are constantly liable to be called on to do. Some Engineer Officers of experience consider that it would be best for the men always to carry tools as well as their arms; but that their kits should be carried for them in the company waggons. This solution appears upon the whole to be the best, because it reduces to a minimum the amount of transport at the head of a column without reducing the efficiency of the engineers.

We would sum up the conclusions as follows:—

1. The field-engineering work of an Army should be ordinarily performed by the corps of engineers. But when necessary, they should have the assistance of working parties of infantry, and in order that this aid may be effectual, the training of all infantry in field-engineering duties should be carried on and extended as far as possible.

2. The field fortification of the present day will consist ordinarily of clearing the field of view and fire in front of positions; making walls, fences, buildings, and woods defensible; making shelter trenches and gun-pits; providing obstacles to secure localities against night attacks, or for advanced posts, or in front of those parts of a position where an enemy's near approach is favoured by natural cover; and in improving communications. Redoubts will rarely be made; but if they are used they must have ample bomb-proof shelter, and the guns which may necessarily be placed in them should have special carriages to enable them to be served over an ordinary parapet without embrasures. Field guns should, however, never be put in enclosed works if it can be avoided.

3. The tools and appliances for all field-engineering operations should be in charge of the engineers, and they should be given the means, and be charged with the responsibility of having them always at the right place at the right time. Special attention should be given to the tools required for felling trees, cutting down hedges, and clearing away cover, and the men should be trained in such operations.

4. Advanced guards and rear guards in an enemy's country should always be accompanied by sections of engineers provided with all needful appliances for removing or creating obstructions; and cavalry sent to operate on an enemy's communications should be accompanied by engineers who, with their tools and materials, should be conveyed in light waggons well horsed and able to move with horse artillery.

5. In order that their duties may be satisfactorily performed, the proportion of engineers with an Army in the field should be increased to two companies for a division, each company having its complete equipment. A reserve company with the head-quarters of each *corps d'armée* should have two of its sections equipped to accompany cavalry, one or both of which should be attached to the cavalry brigade when necessary.

Note.—Since this lecture was delivered, I have been frequently asked to explain more fully, why it is now considered that enclosed works should not generally be attempted in *hastily* entrenching positions; and also, if such works are constructed, why it is rarely advisable to arm them with field artillery, but rather to prepare open batteries or gun-pits for the guns in suitable positions somewhat retired behind the line of redoubts. The reasons which have led to these conclusions are the following:—

1st. A redoubt of weak profile, and unprovided with traverses and bomb-proof cover, is certain to be overwhelmed by the converging fire of artillery before the infantry attack takes place; and even were it possible to keep part of the garrison outside it, in the ditches, or elsewhere under cover during the cannonade, and to get them rapidly into the work again before the infantry-attack was delivered, it is believed that the concentric fire of an enveloping line of skirmishers will make such a work untenable; the projectiles passing over the low parapets of faces and flanks, following the curve of their trajectories and taking the defenders of the opposite faces and flanks in reverse or in enfilade. The larger the work, the more exposed will it be to such adverse influences. If the parapets of the flanks and gorge be made lower than those of the faces, as has been proposed, in order to preserve their defenders in some measure from the dropping fire which passes over the front parapet, the moment an enemy gets in rear of the prolongation of the front faces, he sees their defenders over the lower parapets in rear, and the defence of the front faces becomes impossible.

2nd. A redoubt with a strong profile and sufficiently provided with traverses, bomb-proofs, and all accessories to enable its garrison to contend successfully with a combined attack of artillery and infantry, cannot be made quickly. The preparation and transport of the necessary timber for bomb-proofs, the construction of traverses, and the moving of the mass of earth necessary for the construction of a parapet having sufficient thickness and command, require a great amount of labour and considerable time. None of the redoubts constructed by the Germans round Metz were completed in less than a week.

3rd. The necessary time, labour and materials for the construction of redoubts which give sufficient protection to their garrisons against a modern combined attack of artillery and infantry, can rarely be obtained in the field.

4th. To arm redoubts with field artillery is objectionable in most cases, because the mobility of the artillery is lost in a great measure, and the defence concedes to the attack, the great advantage of being

able to mass guns rapidly at some special part of the battle-field; moreover, if guns are placed in enclosed works, it is to be inferred that they are liable to a close attack, in which case infantry fire is more effective. The guns act to the greatest advantage when they are retired behind their infantry, and therefore can use their long-range-fire effectively on the enemy, while his infantry are too far off to shoot down the gunners and horses.

5th. If sufficient command is given to the parapets of a redoubt to preserve its garrison in some measure from the effects of reverse fire, when attacked by infantry, the mass of earth which must be moved to give a raised terreplein for guns placed in the work, is very considerable, and adds largely to the labour; moreover, this high parapet is a good mark for the enemy's artillery, and guns in the work, particularly if, on its flanks, are much exposed to converging fire.

On the other hand, guns in open batteries or in gun-pits can be placed on the level of the ground, or even sunk below it; much labour is thus saved, while the guns are better protected.

6th. When ample time and means are available for the construction of redoubts, giving adequate protection from modern firearms, the tactical points they afford are as valuable now as they were formerly. It may even be desirable to place guns in such redoubts, either for protection against assault (especially at night), or because the features of the ground point out the same position as most advantageous for the posting of both infantry and artillery.—H.S.

Evening Meeting.

Monday, February 2nd, 1874.

COLONEL F. C. STEPHENSON, C.B., Commanding Scots Fusilier Guards, Chairman of the Council, in the Chair.

NAMES of MEMBERS who joined the Institution between the 20th of January and the 2nd of February.

LIFE.

Josselyn, Frederick J., Captain 96th Regiment.

ANNUAL.

Stewart, J. H., Colonel R.M.L.I.
Whalley, Arthur T., Lieutenant 5th Kent Artillery Volunteers.
Griffiths, A. G. F., Captain, h.-p., 63rd Regiment.
Pigott, H. de R., Lieut.-Colonel 70th Regiment.
Jago, Arthur, Captain 2nd Middlesex Rifle Volunteers.
Sankey, M. H. P. R., Lieut. R.E.
Fry, Henry P., Captain 15th Essex Rifle Volunteers.
Allen, Frederic, Major Bengal Staff Corps.

THE RECRUITING QUESTION, CONSIDERED FROM A MILITARY AND A MEDICAL POINT OF VIEW.

By A. LEITH ADAMS, M.B., F.R.S., Surgeon-Major, London Recruiting District.

COLONEL STEPHENSON AND GENTLEMEN,

WHEN I had the honour of being invited by the Council of the Royal United Service Institution to lecture here on whatever experiences I might command in connection with the "best means of increasing supplies of recruits," I felt that my views and opinions, being more pertinently connected with the medical than the military bearings of the question, would accordingly have little to recommend them to your particular notice. But as with all subjects requiring close and careful attention, it is requisite, in order to accomplish one's work with anything like accuracy, that the collateral issues should be always taken into consideration, or, in other words, in estimating the physical capabilities of the recruit, it is necessary to fully realise the nature of the labour required of him, and the causes which have influenced the quantity and quality of supplies. Now although I cannot plead to what might be called a political acquaintance with the subject, as regards social influences and all the complications in relation to the labour market, and so forth, still, in connecting my daily duties for the last quarter of a century, with the best ideas I could apprehend, I do not find that this recruiting question, as regards its causation, is nearly so difficult of solution as many others which have engaged my attention. In fact any one accustomed to trace effects to their causes has an easy work before him, when he takes up the explanation of the present aspect of the recruiting market; but,

Gentlemen, it is one thing to discover an evil, and another to find an appropriate remedy. I dare say, before our discussions are ended, we shall have various impressions on this subject, and I do hope a successful issue is in store. With this view it has therefore occurred to me that by opening out the vexed question of "recruiting," as far as my efforts are capable, I would at all events be furnishing materials for the criticism of such as take an interest in what we must allow is a matter of National importance.

The question is assuredly a very broad one, and affords much scope for speculation, in which, if we do indulge to any extent, I trust the ideas advanced will have not only facts for their foundation, but be also practical in their application, inasmuch as nothing is more likely to produce nugatory results, than arguing altogether from notions; moreover, I need scarcely add, that in a free and open discussion on such an important subject, it behoves us to lay aside all ulterior prejudices, and look on the matter at issue purely from the standpoint from which all debateable subjects should be considered in this room. This leads me as a worker in a different groove of science from the generality of gentlemen who fill this chair, briefly to express my humble appreciation of the value to the Army and Navy of this admirable Institution, the aim and object of which must necessarily tend to inculcate a more extensive spirit of inquiry, and to encourage officers to exchange ideas on subjects which cannot prove otherwise than beneficial to themselves and to the public services. It has been said of the military as well as of other professions, that a scientific acquaintance with details is apt to create a dislike for practical routine, but we should bear in mind that all art is connected with science, and that no science is worthy of the name which does not serve as a foundation for practice; indeed it would seem, if there is danger of any evil, one way or the other, that the greatest disposition of the present day is either an incapacity or an unwillingness to look on one's profession in any other light than that of a serviceable craft. The gigantic progress made by science of late years has been nowhere more apparent than in the profession of arms; indeed, considering warlike inventions alone, it would almost seem, that if war and strife between nations will ever cease, they are just as likely to be made impossible by science as by diplomacy; moreover, looking at Western Africa at this moment, and at the work which is being accomplished by the distinguished Commander and his selected companions in arms, and chiefly to the great war lately played out on the continent of Europe, it might well be said, that, however much military success may have heretofore been dependent on brute force and the chapter of accidents, it is in these instances owing to a profound acquaintance with the science of warfare; not only the mere knowledge that comes to us from routine and the exercise of common sense, but from minute and careful study of the subject in all its ramifications and details. In the same way, I feel that the theme of this lecture should be treated; but I am afraid it is beyond my powers, even if time would allow, to do anything like justice to the main facts, much less to enter into particulars.

The most dismal and desperate view of the aspect of our Army at

the present time is that which associates the physical degeneracy of the soldier with a general falling off in the strength and stamina of the population.

Thus there is an impression that the British soldier is no longer the man he was, and that if England had to take up arms suddenly, she would find herself at a very great disadvantage with other armed Powers; moreover, it is also asserted that the evil portends the coming decline, not only of our military renown, but is a sign of national decay.

Now gloomy and exaggerated as are these forebodings, there is no gainsaying the fact that the numbers and quality of recruits have been steadily declining of late years, more so since the introduction of short service, and the doing away with pension and bounty on enlistment. Many of us can call to remembrance the days, now long gone by, when the recruiting sergeant, prim, and like a nine-pin, stalked down the street on market day, with his colours "gaily streaming," and the country bumpkin, in blouse, and often much the worse for convivialities, but not a little proud of the ribbons pinned to his cap, went off to join the good old depôt companies, or the head-quarters. Scarcely a ghost of those times is left. A few smart lads of 5 feet 7 inches in height were then only required, now we are in need of many of a much lower standard, and cannot get them. No doubt the old *régime* had its faults and weak points, but the stratum of citizenship on which the sergeant practised was superior, both morally and physically, to that from whence the majority of recruits are now obtained. Indeed, ever since the Crimean war, there has been a steady falling off in the recruiting market, not only as regards the supply, but the physical capabilities of the men. The causes of the evils are numerous. It would be absurd indeed to ascribe them to any one cause in particular, whilst by allowing for the great social changes of the last 20 years, and the vast increase in wages and in emigration, there is no difficulty in seeing that in order to obtain soldiers, we must compete with the labour-market. Again, it must be remembered that we are not a military people, and every year is somehow, making the Briton less and less disposed to sacrifice his inherited love of freedom for the necessary restraint which, as a matter of course, is inseparable from efficient military organization.

Emigration has also contributed, especially in Ireland, to thin the superstratum of stalwart youths, who, in rags and tatters, were wont to crowd the barrack gates, begging for military service.*

The days are past and gone, some say beyond redemption, when the

* This is amply shown by comparing the total number of recruits inspected in the United Kingdom during 1872 and 1860. Thus per 1,000—

1872.		1860.	
England and Wales furnished	820·0	England and Wales furnished	566·0
Scotland	100·8	Ireland	321·0
Ireland	72·4	Scotland	107·0
Colonies	6·8	Colonies	6·0
	1,000		1,000

adjutant turned them away by dozens, and when the recruiting sergeant would not look at the aspirant he is now glad to obtain; moreover, the class of labourers who, 20 years ago, could scarcely keep body and soul together, are far above accepting military service, at all events under the present conditions. It was all very well during "the long peace," when the Army was a mere skeleton, as compared with the present, and recruits were very plentiful; then, our infantry was the finest in Europe; indeed the linesman and marine of those days was about as perfect, as regards stature and muscular development, as could be wished, seeing that the average height of many battalions was 5 feet 7 inches. By the side of such men, the French infantry soldier looked a dwarf; indeed as regards the latter no one who has seen the puny linesman of the late Imperial Army in full marching order, but must have been impressed with the belief that he was ridiculously overweighted; and from all accounts his *physique* materially deteriorated after the Crimean war, so as to contrast in a remarkable manner with his late foeman.

I have heard it repeatedly suggested, that, in order to secure perfect bodily efficiency on enlistment, no man should be taken in our Army under 20 years of age, or under 5 feet 6 inches in stature, so that we would begin with a standard of height several inches in advance of that of any of the great European Powers. The fact is, some critics, without taking the great social and political changes of late years into account, are apt to measure the requirements of the present day with their experiences of the past. Thus, I repeat, it was all very well in times gone by, when few soldiers were wanted, and there were more candidates than vacancies; but now it would appear, even with the most reasonable offers, that the demands could not be met by men of this age and height.

When we attempt to compare the relative heights of the soldiers of various countries, it is apparent that a great deal must be allowed for the constitutional or race peculiarities of a people and the system pursued. Looking at the capacities of the human frame, and judging from what one knows of the physical powers of the Anglo-Saxon, I apprehend that our minimum military standard of height, although apparently high as compared with that of either France or Germany is, considering all things, on the border line of the physical efficiency of our people. I will explain this better presently. In the mean time I beg to direct your attention to the lowest military standard of height in the British, German, and French Armies, as shown in this Table:—

	Minimum Height.	Minimum Age.	Duration in Active Army.	Duration in Reserve.
British	64·5	18	6	6
German.....	61·8	20	3	4
French	60·3	20	5	4

Now with reference to two of the most important elements of

physical efficiency, viz., age and height, it will be observed that whereas of the three armies, England employs the youngest, the French use the shortest men in warfare, both weighty considerations from a medical point of view. It must at the same time be remembered, that, however short, the conscript must be twenty years of age, whereas a large number of our recruits are under eighteen. Again, although our minimum standard of height at present is considerably in advance of every other European Army, excepting Sweden (also in part composed of volunteers), it does not prove that we would get the same efficiency by reducing our standard to their level.

In an Army dependent on a voluntary system for supplies, more especially if the service is unpopular or the numbers apt to fluctuate, it becomes necessary to extend the range to the limits compatible with efficiency so as to afford scope for selection. The limits of age in our service are 18 and 25, whereas the same in the Swedish ranges from* 17 to 30; indeed, practically the latter may be said to represent the true ages of a large number of our recruits who nominally state that they are 18 or 25 years of age. It must nevertheless be borne in mind that, whatever difficulties accompany voluntary systems of enlistment, selection can be practised to an extent incompatible with the rules of conscription.

With regard to the stature of various nations, and to what anthropologists designate race characters, there are pronounced differences in *physique* as well as in relative powers of endurance.

For instance, a people of low stature may be as physically fit to accomplish deeds of arms as a larger stock, there being differences in the relative capacities of the chest and other organs in various nations. I will give you an instance which came under my own notice. The Tartars of Thibet are a race of very low stature, yet they have in proportion very large chests, which in all probability have been acquired by breathing the rarefied atmosphere of the elevated regions they frequent. Again, a very distinguished Frenchman tells us that "if "we draw a line passing by Cherbourg and Nice, we shall divide "France into two distinct zones as regards the appearance and height "of the inhabitants. In the south-west, the ancient Celtic population "is of small height, as is proved by the great number of military "exemptions."†

Now allowing the Celtic character, I cannot help believing that a height of five feet with even a fair proportion as regards weight and

* The minimum age and height in the Roman Army was 17 and 5 ft. 3 in. When the recruit had completed his drill, he was tatooed on the hand with a mark (*puncta signorum*). Vegetius lays down specific rules for the examination of recruits (*tirones*).

† Pouchet on the "Plurality of Races," and Broca "Recherches sur l'Ethnologie de la France." This author places the tallest peoples of Europe as follows:—The Anglo-Saxon, German, Norwegian, and Albanian; the shorter varieties being the Southern French and Spaniards, Irish, and Maltese. I agree with the English translation of Pouchet's work that the inhabitant of the south of Spain is not small, and as regards the Irish, the same may be said. The Maltese have a great deal of Arab blood in their veins, and although of low stature as compared with Englishmen, are wiry, and display considerable powers of endurance.

chest at 20 years of age, is a low standard for military efficiency. Indeed as regards our race as it exists in the British Isles, I feel convinced that not one man in ten of that standard would be found eligible for the wear and tear to which our soldiers are subjected. The question of tall and short races of men depends therefore on the characters natural to a people; at the same time, should the race be subjected to debilitating influences such as obtain in crowded cities, or a long and continuous drain on its youth through the requirements of war and emigration, whereby the able-bodied portion of the population is taken away, the natural consequences so far must be a deterioration of the race as regards *physique*. Now although as a nation we are yet strong and vigorous, still there cannot be a doubt as regards Ireland, that a serious flow of her able-bodied youth has been setting towards America for many years, so much so, that it may be a State question, sooner or later, how the drain could be prevented. Looking at the steady decadence in the number of recruits furnished by Ireland now as compared with the past, it might be fairly asked, is the same stamp of soldier of twenty years ago still as numerous on his native soil? Is it the case or not that our race in other lands is draining the life blood of the old country and leaving the stunted and infirm behind?

The point, however, which concerns us practically is how far emigration, coupled with political influences, have affected recruiting? As regards England and Scotland, it is quite evident that an unprecedented demand for labour of all sorts and an advancing rate of wages have absorbed the bulk of the able-bodied youth who would have enlisted in former years, so that failing them, the physical standard had to be lowered, and we have been driven more or less to select soldiers from among a class of the population notorious for containing elements of physical degeneracy; for example, the pallid yet intelligent and active lad frequently met with in cities, precocious for his years, and indicating an advance in his real age, can be easily obtained of a standard between 5 feet and 5 feet 5 inches in height. The weight of such an individual is seldom over eight stone, and considering the smallness of his bones, he is fairly covered, but there is altogether a want of vigour and that healthy promising aspect which should characterise a youth of his years. These lads attain their full growth before 20, and rarely increase an inch between 18 and manhood.

Now during war, panics and sudden augmentations, when the standard height is reduced to 64 inches, a large number of these men get admission into the service; in truth it is then more than on any other occasion that there is a danger of introducing inefficiency into the ranks. I desire particularly to indicate this type of ineligible recruit, as he belongs to that unimprovcable, stunted and staminaless race met with in crowded cities, and which always indicates a falling off from the standard of physical efficiency; if therefore there is one plea for the maintenance of a Reserve more cogent than another, it is that deducible from these very facts.

Now, if I have made this aspect of the question sufficiently clear, you will perceive that it has important bearings on recruiting. Thus,

the low stature of the soldiers of France as compared with that of other countries, may not be so much a measure of policy, as of necessity, when we think of the terrible drain on the able-bodied portion of the population made by warfare alone, during the last 70 or 80 years. Moreover, it must be conceded that a competition unexampled in history has been going on for many years between the New and Old Worlds, and whilst many laugh at the very idea of exhaustion and assert that only superfluous populations are emigrating, others throw out opinions that unless this exodus is checked, our race as it exists in Great Britain will insidiously go on declining in numbers and in stamina. There is no more obscure problem than that which seeks to demonstrate the causes of the extinction of races of man, and statistics unfortunately do not bridge over the difficulty; for after all it is not the numbers we desire so much to compare as the vigour of the race, for the former might double themselves, and yet the race be inferior in physical strength. I merely indicate these points in order to show that in framing any scheme for levying soldiers by the selection of the ablest portion of a population, and more especially should the levies be volunteers like our recruits, it is requisite to weigh duly all the causes and influences which have hitherto impeded or furthered supplies. Looking at the physical capabilities of the Anglo-Saxon, it is probable that any standard under 64 inches in height would bring very few recruits of the minimum age or even up to 21 of sufficient muscular development.

A good deal of course depends on the normal standard of individuals, but, from a mass of data, I have come to the conclusion that about 3 inches is a fair allowance for growth between 17 and 26 years of age; so that a lad of 64½ or 65 inches in height at 17 or 18 should be 67 or 68 inches in height at 26 years of age. This was the average height of the finest infantry battalions before 1854. Again, no man of 21 years of age with a height of 64 inches is likely to add more than, or even as much as, one inch afterwards. It will therefore, I think, be found that our most able-bodied soldiers have shown at least a height of 66 inches before 21 years of age.

A well-nourished lad between 17 and 18 should therefore be from 64 to 65 inches in height, and 9 stone in weight; indeed, looking at the hazards incurred in accepting a lad of 17 and 64 inches in height, it should be made a rule that such an individual ought to weigh at least 130 lbs.

In estimating the physical capabilities of the soldier, there are no more important elements of proficiency than the relations of weight and height, to age. Unfortunately, however, the majority of our recruits are not in their normal bodily conditions, as every one knows, who has observed the marvellous progress frequently made in the weight of lads after joining their regiments. Of course, there is no laying down rules applicable to every case, but looking at the requirements of the various branches of the service and the general principles which seem to indicate the stamp of man best suited for them, I have from time to time made selections of such recruits as appeared to me typical specimens of cavalry, artillery, and infantry soldiers at the age of 25. As examples, the following may be of some interest:—

a. The type of the infantry soldier is assuredly best seen among the agricultural and labouring classes. His matured height is from 5 ft. 7 in. to 5 ft. 8 in., chest-girth, 36 in.; and weight from 145 to 150 lbs. The circumference of the thigh at the middle being 21 in., and the forearm 11 in. The man of 5 ft. 5 in. in height should weigh 126 lbs., and give a chest-girth of 34 in.

b. The rifleman of 5 ft. 4 in. should possess a minimum chest-girth of 35 in., and weigh 130 lbs.; the thigh and forearm girths being 20 and 11 in. respectively. Such men would form the *élite* of the 60th Rifles and the Rifle Brigade, and make excellent artillery drivers.

c. The gunner required for heavy ordnance and the heavy dragoon, should not be under 5 ft. 7 in. or 5 ft. 8 in. The former would be admirably represented in a man 5 ft. 9 in. in height, weight 160 lbs., chest 37 in., with a girth of thigh and forearm of 21 and 11 in.

d. A splendid regiment of heavy dragoons could be made up from men 5 ft. 9 in. in height, 140 lbs. in weight, with a chest-girth of 36 in., and thigh and forearm of 19 and 10 in.

e. The lancer requires a long arm and leg, more so than the hussar, from the differences in the nature and use of their weapons. The type of the former is displayed in a man about 5 ft. 9 in. in height and 35 in. in chest-girth, with rather small limbs and weight of 140 lbs.; thigh and forearm, 16 and 10 inches. The lower limb of such a man should measure about 38 inches from the fork.

f. What may be called the typical hussar stands about 5 ft. 6 inches in height, is 132 lbs. in weight, with a chest of 35, and thigh and forearm of 19 and 10 inches.

In fact, it is the harmony between age, weight and stature, which constitutes the greatest perfection of bodily development.

I now pass on to the consideration of the age of the recruit.

It is quite a mistake to suppose that the recruit is, on an average, younger now than formerly, for during the operation of the unlimited and 10 years' service warrants, lads were taken at 17 years of age provided they were 5 feet 6 inches in height. Thus in 1845, for example, out of 1,000 recruits 750 were under 20 years of age, whereas in 1873 there were only 580 per 1,000.

Thus, more youths were enlisted in those times than now. But it must be borne in mind that there are great discrepancies in the heights and weights in these two periods. Taking the height, I find from numerous calculations that the ratio was as follows :—

	1845.	1873.
Under 66 inches	105	364
Between 66 and 67 inches	473	433
„ 67 „ 68 „	204	111
„ 68 „ 69 „	111	62
„ 69 „ 70 „	74	15
„ 70 „ 71 „	16	12
„ 71 „ 72 „	17	3
Total	1,000	1,000

I will not take up time with further proofs on this head. Suffice it to say, that these youths of 17 were superior in *physique* to the majority of the recruits of 18 we are now accepting.

In addressing an audience composed more or less of members of a different profession from my own, it is not easy to simplify technical data; and yet I feel that in making assertions I should be in a position to support them by facts. I trust, however, you will accept the truth of what I am about to state with reference to the recruit and young soldier, viz., that in the whole range of science there are few data more firmly established than those which refer to the growth and capability of the human frame.* But the cumulative experiences of all great military commanders bring the matter home to us in a clearer and more practical way. Napoleon, Wellington, and all competent observers since their day, have constantly inveighed against growing lads being considered capable of enduring the hardships and fatigues of warfare; consequently, in armies raised by conscription, the minimum military age has been fixed at twenty. Now, in our service it has hitherto been impossible to meet the most ordinary demands by recruits of this age, and looking to the present state of the labour-market, it seems scarcely likely, even with the best inducements, that the majority of recruits will be over 19 years of age.

It is right, however, in estimating the physical capabilities of the young soldier of to-day, to bear in mind that, whatever remains to be done, a great deal has been accomplished of late years in improving his physical, social, moral, and intellectual qualities. The dress and accoutrements are better adapted to his duties in various climates; to wit, the old knapsack has been replaced by a better pack, less cumbersome to his movements, and not so heavily laden; his bodily powers are developed by well-directed exercises. Schoolmasters, libraries, reading rooms, and out-door recreations are all within his grasp, whilst his dietary and barrack-room have been much improved; indeed, as far as his creature wants and requirements of health are concerned, there is no doubt whatever that he is in advance of the soldier of every other country. Again, we have seen that it was the custom in former times, when the political state of Europe did not call for a large British Army, and when recruits were plentiful, to select only men of large stature; but in those days there were no camps, no manœuvres, or one-half of the trying work to which our young soldiers are now exposed, so that the lad of 17 grew up to manhood in easy country quarters with far fewer chances of getting his frame over-taxed than the youth of the present day; moreover, physically he was better fitted to withstand the strain. Now it seems to me most advisable that, for duty purposes a very broad line should be drawn between the nature of the immature and of the fully developed soldier. This is a subject on which I could enlarge to an extent that would prove beyond cavil, that it is not only pernicious to the interests of the service, but also cruel to expect a lad in his "teens" to do the work of a full-grown man. I speak emphati-

* See an excellent little pamphlet on the "Growth of the Recruit and Young Soldier," by Professor Aitken, of the Army Medical School, Netley, published by Bohn and Co. 1862.

cally on the matter from a consciousness that the evil consequences of over-work, although apparent to the surgeon, are not sufficiently estimated by many military men. At the same time there cannot be a doubt that with a voluntary system of enlistment and the requirements of the country, we shall never be enabled to obtain recruits of matured years; nor need this necessarily be a matter of regret. At present many promising lads of 17 pass themselves off as 18 years of age, and as they form the largest number of recruits who seek to enter the service from choice alone, consequently they are the more likely to remain, whereas older men having taken to remunerative employments, rarely enlist except through pressure of circumstances. Now, as Professor Parkes justly observes in his admirable work on Military Hygiène, "If the State will recognise the immaturity of the "recruit of 18 years of age, and will proportion his training and his "work to his growth, and will abstain from considering him fit for the "heavy duties of peace and for the emergencies of war till he is at "least 20 years of age, then it would seem that there is not only no "loss but a great gain by enlisting men early."

The question, therefore, comes to be, "How is this to be done?" Already a step in the same direction has been accomplished by sending only men of 20 years of age to tropical service. Is it visionary to propound a doctrine of the following description? Considering that very many lads of promising *physique* can be obtained of 17 years of age, what are the objections to enlisting a limited number and (as in the Navy) training them to their profession until they are capable of serving with the colours?

If, as it appears from the views I apprehend regarding the recruit of to-day, that by the principles of a voluntary system we shall always be subject to the acceptance of lads in their "teens", why should we not look the difficulty in the face and meet it by appropriate measures? But there are other obstacles to be overcome. At present, what with all the larger recruits being taken for cavalry and artillery, and the sending men of 20 years of age to India and the colonies, the home battalions of infantry are composed more or less of lads under 20 years of age, and men of small frames.

Taking our race-characteristics into account, it seems to me that the grand aim at all hazards should be to maintain a height of not less than 5 feet 7 inches for the soldier at his prime of life, which is about six-and-twenty. This, of course, will best be accomplished by extending the field for selection, or, in other words, creating better inducements to enlist. Now I must candidly assert that the *physique* of our infantry is not at present up to the standard of our race, and I cannot conceal from myself a feeling that unless remedial measures are adopted, it will sink lower and lower. This conclusion has been arrived at mainly from my personal inspection of about 25,000 recruits, over 17,000 of whom have been passed into the Army. But it needs neither numbers nor minute observation to demonstrate the facts of the case, and I need not waste time by further demonstrations. Before, however, passing to the remedial measures, I may dismiss this portion of the subject by an aphorism established by no

less an authority than the Duke of Wellington, viz., "that the power of "the greatest armies depends upon what the individual soldier is "capable of bearing and doing." Indeed, if reduced to mere numbers and improvidence of life, a nation might always assemble bodies of its undeveloped youth and undergrowth, and accomplish great deeds at a reckless waste of numbers, but strength and efficiency are only to be obtained by a careful selection of the best developed, or in other words, scrupulous attention to the physical capabilities of individuals. Considering, therefore, the very varied and trying duties our soldiers in comparison with those of every other country are called on to perform, it must, I think, be justly conceded, that they should now as much as ever, be in possession of the stamina of the best of their byegone race. Better, weak battalions of able-bodied men than strong regiments of small men and striplings.

It may seem that I have dwelt at unnecessary length on the physical requirements of the recruit, and on points of small import in event of the supplies being greatly increased, so as to allow of better selection. This may be true or the opposite, and I shall be glad to find that the errors and evils I have just indicated will be rendered impossible by the provisions of some well-assorted recruiting scheme. But if there is any reliance to be placed on the signs of the times, it appears more than doubtful if the moneyed interests of this country will admit of a large number of the *élite* of the population spending the prime of their lives in military service; indeed, "the recruiting-question" has an important political element in its composition; and here it is that I feel my inability to grasp its bearings. All that anyone in such a position can hope is, that the nation, spurred on to a sense of right and duty, will not stop short in accomplishing measures which shall put an end to all makeshifts; in fact, a straightforward business transaction, when the recruit exactly knows his choice, or, in other words, a compact based on the broad sound principles which should guide every citizen in the discharge of the duty he owes to himself and to his fatherland.

It would be quite beyond the compass of an hour's discourse to detail the numerous individual schemes for bettering supplies of recruits for the Active and Reserve Forces. If I succeed in pointing out the main points at issue, and their collateral relations, I shall feel I have so far accomplished my task, which is to sum up as many facts and ideas as possible, and put them before you in a manner calculated to draw forth the impressions of individuals who have devoted attention to the "recruiting-question" in all its manifold phases. This question must in the nature of things be exceedingly extensive and complicated; indeed, the very fact of maintaining an Army equally for home and foreign service, on a system of voluntary enlistment, is singular in itself. Moreover, looking backwards into time, and into the lap of the future, and by comparing the social conditions of the past and present generations, the increased and increasing demand for skilled and unskilled labour, together with the allurements of new countries, it may fairly be asked on the threshold of our inquiry, Will any plan succeed short of compulsory service?

Now, with reference to the incentives which have hitherto guided recruits more or less on entering the Army, we find much difference. All do not argue one way. Many think less of the daily pay than their future prospects; others cannot realize Short Service and the Reserve. "Once a soldier always a soldier" is, I find, a well-known rejoinder to the recruiting sergeant's endeavours to put a gloss on the prospect by showing that after six years' service with the colours he will join the Reserve on the retaining fee of 4*d*. per diem, and be enabled at the same time to pursue the trade or calling he practised before enlistment. To me there seems a ring of prophetic import in this, I may call stereotyped, reply of the recruit of to-day; at all events, it appears to carry this meaning; that, whatever allurements are held forth, six years' active service followed by a return to civil life, should be made on better terms. Again, a very large number enlist quite regardless of any pay or prospect considerations, and altogether through pressure of some kind or other; and there is a class who, knowing the facilities in the way of desertion now-a-days, enter at one door and go out at the other. Moreover, recruiters allege that the military ardour which stimulated many a youth to take the shilling, is now gratified in the ranks of the Volunteers, and doubtless the bounty enticed not a few of the reckless, who would have willingly deserted a week afterwards and taken any number more, but for the dread of being flogged and tattooed, which explains more or less the cause of the increasing desertions. Hence, as far as a round sum on enlistment is concerned, it is extremely doubtful if such a measure should be reverted to; however, it is well worthy of consideration how far the principle might be carried out with reference to the future of the soldier. Thus, it has been suggested to give a lump sum on completion of the period of active service, whatever that should be, so as to start him when he settles down in civil life, the idea being that the recruit can safely look forward to be better off when he leaves the Army than when he joined it. One of the simplest and most feasible suggestions of this description is to add say 2*d*. a-day to the present pay. This sum is to be allowed to accumulate, and be credited to the soldier monthly in the regimental savings-bank and in his ledger, and to be only payable after discharge, or, in the case of death, to the next of kin. Again, in case of a soldier being permitted to re-engage for a second period of service, his accumulated pay should remain in the savings-bank at interest till his death or discharge, and the extra 2*d*. per diem be paid to him as an augmentation to his pay. Thus in completing his service for pension, he would have a nest-egg,* besides the pension, and, considering all things, what better prospects should he expect?

A novel and ingenious scheme, under the somewhat unprofessional designation of "co-operative enlistment," has lately been propounded. Like many other mental views of the recruiting question, it looks also very well on paper; but I must confess that I do not see how or why

* At *six* years' service, the sum would be about £20. There are considerations, however, in keeping interest accounts for a large number of men, not only troublesome, but in field service absolutely difficult; however, the paymaster would, no doubt, be equal to the emergency in this case.

we should rate the work to be done by the soldier in such a commercial, speculative, and actuary-like way. Surely the grandeur and greatness of this country are of some consideration, not to mention the feeling of patriotism, which, in spite of all wrongs unredressed, should be uppermost in the heart of every Briton. Now, allowing these their rightful share, however small, it next comes to be a question for consideration, what moneyed interests will best secure the services of the working man? Not by out-of-the-way projects, but 1st, by some extension of, or improvement in, the prevailing system. 2nd. In the event of the latter proving utterly impracticable, by the next best scheme, founded on experience, and recommended by persons who have devoted their best attention to the subject in all its particulars.

The Short Service and Reserve Act of 1871 aimed at, 1st, improving the social position of the soldier; 2nd, mobilising the Active and Reserve forces; 3rd, popularising the Army; and, 4th, forming an efficient Reserve. The question comes to be, How far has it met these important requirements? As to its good intentions, there can be but one opinion, and had the enrolment been compulsory, there could scarcely be two notions on the likelihood of success. With reference to the third, it is clear that the experiment of popularising the Army has yet to be tried. Indeed, of all the influences which of late years have acted with increasing strength in making military service unpopular, none have been more potent than the disparaging accounts disseminated by soldiers themselves, and in particular the very men who formed the nucleus of the Reserve, for the reason that many were inordinately discontented when serving with the colours, and thus, disliking their work, readily volunteered for the Reserve, where they have done little else than grumble and dissuade others from following their footsteps. Lastly, as regards the formation of an efficient Reserve, it is apparent that the provisions of the scheme are defective in several important bearings.

It is not always safe to trust to individual impressions on affairs of life, however experienced the authority may be, and one must not reckon too much on the discernment of the past in regard to the requirements of the present generation. I believe, however, the following aspects of the recruiting-question, as regards the Short Service and Reserve Act of 1871, deduced more or less from the opinions of practical observers, and substantiated to a considerable extent by events, will be found worthy of your consideration.

Take as an example a lad nominally 18, but, like the majority of recruits, virtually about 17 years of age, without any fixed occupation. What are his prospects on enlistment? At the age of 22, just when he feels himself well up to his work, and after realising the vicissitudes of Army service, he is suddenly called upon to give up a life of certainty for one of uncertainty, with a retaining fee of 4*d.* per diem, to begin some new career without a coat to his back. Who is to employ this man, subject to be removed at any time? or is he likely to retain himself? It has been proposed to open up all available Government appointments for men of the Reserve, which, however, is only one way of employing them.

Again, if the recruit be a tradesman, he will find six years just enough to make him at all events rusty, as regards his former craft, with the same eventuality awaiting him as in the last case.

Supposing the recruit pursues a trade when in the Army, will that make him in anyway more bound to the Service when in the Reserve?

I have stated that a great many, indeed, perhaps the majority of recruits enlist through pressure of circumstances, very often within their own control, and frequently of their own making. But be that as it may, if the ranks were always the last resort, they are now more than ever the catholicon for persons who cannot or will not help themselves. Can we therefore-in justice to human nature, expect great things under such circumstances? To me, one of the strangest anomalies in ethical science is the military ore before the slag has been removed, and afterwards when refined by discipline and training. Our forefathers, understanding the class of society from whence recruits were obtained, made suitable rules; we, wishful to improve the material, have suddenly abrogated these rules, and still the same, nay even a lower residuum of society has enlisted, accompanied, as might be expected, by increasing desertions. But I need not take up time in recounting what all practical observers know much better than I can tell them; suffice it to say that in looking to the past, with the eventualities of the future, to wit, war and invasion panics, however much the Act of 1871 has fallen short of its good intentions, there surely cannot be a doubt that no plan will now-a-days be more than half perfect, which does not provide for an efficient Reserve of some sort.

A good many Officers of experience are of opinion that service in the Reserve should be made optional, but in the very face of this proposition, is the danger of the latter dwindling down to insignificance. Again, it is suggested that the soldier should receive a small bounty in the first place, and that he should, when he re-engages receive additional pay. There is an opinion also that the purchase money should be reduced so that the soldier might save up his earnings and buy himself off honestly, instead of resorting to desertion. Some authorities advocate a free ration, and I have often heard a strong impression among Officers and old soldiers, that the pay, position and prospects of the Non-commissioned Officer should be materially improved, so as to make the grade worthy of the consideration of a respectable class of tradesmen.

It is also advised that railway, steam-boat, warehouse, and numerous other mercantile as well as Government appointments, should be freely bestowed on pensioners. Moreover, besides these and other suggestions in relation to the pay and prospects of the soldier, it might be fairly asked, is there any way by which his social position could be improved? I refer particularly to civil rights. Why should not a soldier who serves or has served his country, enjoy by virtue of his calling, certain social privileges beyond his compeer in civil life? Our soldiers go forth to battle, and after sweltering in deadly climates return to their native land to receive no more consideration, if actually as much, as the meanest citizen; indeed, disregard is a mild meaning for the public

mode of estimating the indebtedness towards him, who is always ready to give up his life for his country!—

"The brave poor soldier ne'er despise,
Nor count him as a stranger,
Remember he's his country's stay,
In day and hour of danger."

It is a full century since this reproach was penned by one of his own order—a common ploughman! at the same time, one of the greatest geniuses of our country; and yet it is left to us and to the like of us, to be hinting that it might be well to make amends for the neglect of our predecessors.

The Militia has hitherto been the natural Reserve, indeed the fountain head of the active forces, and in times of pressure the chief recruiting mart. Its machinery also admits of much amplitude, and in consequence is capable of being made beneficial to the active Army not only in the way of ordinary supplies, but as a Reserve. This is a subject however I cannot venture to discuss at any length. Indeed, supposing I was capable, it is manifest that, considering the specific differences between the military and civil elements in both services, there are many prejudices to be overcome. I well remember during the Indian Mutiny when employed in beating up for recruits in conjunction with a military Officer, that we happened to visit a very well-known Militia regiment. After the orderly-room work was over, and we had succeeded in obtaining a few volunteers, the Commanding Officer said to us, "Gentlemen, I hope you have been successful; and "my Adjutant is reconciled to his fate; but for the last twelve months "we have always been experiencing the sad truth of Ovid's words, "'Sic vos non vobis nidificatis aves.'"

Now how is this reconciliation to be diverted towards the necessities of the active Army, not only in the case of the Militia but also of the Volunteers? Certainly not by making the three services more and more independent of each other; but on the contrary, by every effort compatible with expediency to bring them into the closest relationship; that is, supposing the Militia should be considered as the mainstay of the active Army. The impressions of experienced Militia Officers on this head seem to bear all in one way. If the Militia is to be efficiently utilised, it is the opinion of several with whom I have communicated, that the Militiaman's "enlisting bounty" should be continued, and also the "training bounty," for the reason that he enlists usually when work is slack, and the latter is his pocket-money when he has passed through his instruction. In fact, as has been shown with reference to the soldier at the termination of his first period of active service, it is suggested that a little liberality at the proper time, and the exercise of the priceless commodities—tact and common sense—will accomplish wonders, and knowing from observation how very little turns the scale when the soldier has completed his first engagement, I can well believe that a little inducement to serve on, would in the main be of advantage to the Army. No doubt your discussions will elicit many important facts and suggestions I am incapable of even indicating, more especially the best ways and modes

of securing a regular flow of recruits from the Militia into the active Army, and how the regular soldier could complete his service for pension in the Militia, should the latter become the Reserve of the former? As regards the bond of union considered advisable to be cultivated between the Active and the Reserve Forces, it has been very emphatically represented to me by a Militia Officer of experience, that every consideration ought to be shown towards regiments when called out for training, that instead of subjecting them at inclement seasons to the discomforts of tent life, they should be placed in barracks, and that the Militia and regular recruits should be drilled together as much as possible. Moreover, that the training should not only be conducted with the regular forces, but that every exertion should be made to supply the Militia with well-instructed Non-commissioned Officers, so as to correlate the two services as much as possible.

It would be useless and uncalled for at present to enter on any discussion relating to the advisability of service in either the Regular or Reserve Forces being made compulsory; at all events until the best directed measures compatible with the interests of the country have been proved insufficient; then it will surely be full time to bring home to every citizen that he has a country to defend and colonies to protect. Be that however as it may, the military historian must always dwell with pride and satisfaction on the past achievements of our Armies raised and maintained by a voluntary system. This indeed displays the unique position England has hitherto held in regard to the formation of her armed forces as compared with other countries. How her battles have been fought! how her colonies have been captured and held by volunteers! and to those who have seen the raw material from which the British soldier is often manufactured, it must be a matter of wonder indeed, that he should turn out the splendid fighting man he has hitherto invariably proved himself to be, in every clime and in every possible emergency! But, Gentlemen! tall or short, lowly born or nobly bred, the old innate British pluck still pervades our race. All that is required is to keep up the numbers and stamina, and the valour will take care of itself; for as Cyrus said to the Greeks on the eve of Cunaxa, so might it be said of our soldiers: *Ὦ ἄνδρες Ἕλληνες οὐκ ἀνθρωπων, απορῶν βαρβάρον συμμὰχους ὑμᾶς ἄγω ἀλλα νομίζων αμεινονας καί κρείττους πολλῶν βαρβάρων ὑμᾶς εἶναί ἐιὰ τοῦτο προσελαβον.*

The CHAIRMAN: It is proposed to divide the discussion under two heads, as far as practicable. The first point will be, "Can a perfectly efficient system of short service and reserves be secured by voluntary enlistment?" The next point will be, "Supposing short service and the reserve impracticable, what scheme of continuous service and pensions is likely to be successful?"

Dr. CAMERON, Deputy Inspector General of Hospitals, h.-p.: The observations I wish to make are entirely of a practical kind. Dr. Adams has very ably put before you the difficulties and the statistics of our recruiting service, but we may consider these for months, and at the same time never arrive any nearer the solution of our difficulties. I think the main root of our difficulties is to be found in the extraordinary anomaly which prevails in our service, and which renders it different from all the services of Europe. Anomalies are exceedingly common in the British Constitution, and however theoretically absurd, a great many of them are admirable in practice. There is one anomaly, however, which is not so, and that is the

management of a large Army comprising hundreds of thousands of men by a body of civilians. I consider that is the root of a great deal of our expense, and of the failures and blunders in our military service. If His Royal Highness the Field Marshal Commanding-in-Chief were, as he would be in another country the Minister of War, and if that large building in Pall Mall were occupied by a body of Staff Officers and subordinates all wearing our uniform and having served in the ranks of the Army that they were called upon to administer, we should have a very different state of things. What do we see now? Warrant after warrant promulgated with crude haste; and these warrants are not issued tentatively, or tried upon a brigade or a few regiments, but no sooner does the service endeavour to accustom itself in all its branches to one set of regulations than they are cancelled, and out comes another set. The consequence is, nobody knows what they are to trust to; and among the causes of failure in recruiting, is the wide-spread belief throughout the country, that nothing can be depended upon. Men have entered the Service, and they have found everything that existed when they entered the Service swept away as a dream, and no one knows what may not come next. The ideas of those who draw up these warrants and promulgate them, seem to be, that the British soldier is only to be got at by pennies and halfpennies a day; they do not give him credit for higher notions. They seem to forget that the British soldier is animated by the same feelings as the British Colonel or General,—that he is quite as capable of enthusiasm for his country, and quite as capable of looking to his own prospects in life. Would any body of military men who knew what a barrack was or what barrack opinion was, have ever promulgated warrants such as those that Dr. Adams has described? They ask men at 17 or 18 years of age, when they are endeavouring to get into trade, to go and enlist to go to any part of the world, to sever all connections and all interests, and to give up the best time for establishing themselves in life, and all for what? for a bare subsistence, a miserable subsistence for the time, and then to be turned adrift a few years afterwards to endeavour to re-establish themselves and to find every avenue filled up by other people. Still more absurd is it to open the door and call upon men to take fourpence a-day and go into the Reserve. What chance is there that these Reserve men will ever be seen again? A few days ago I was speaking to an old soldier of 19 years' service, and I said to him "What about this Reserve; is it worth the paper it is written on?" He said, "No, it is not." "What do they say in your regiment; how many do you think "would ever serve?" "Not one in ten," was the reply. They do not make any secret about it, but they say "Catch me here again! I will screw out all the four-"pences I can get, and then I am off to America." And if that plan of storing up the twopences and giving the men £20 were adopted, what use would he make of it? Do you think he would join the Reserve to be liable to be called upon to leave his wife and children? No; he would take himself off to the Colonies. The whole secret of recruiting is simply the law of supply and demand, and of remuneration. Whatever may be said of the state of the recruiting service at present, and the indisposition of our people to enlist, I do not admit that our military spirit or pluck is in the least degree diminished. Our manufactures, our trade, and the fact of congregation in large cities, no doubt reduce our physical standard, but I do not admit for a moment that there is any diminution in the pluck, the adventurous spirit, and the bravery of Englishmen. You see it. I need not dwell upon such trite matters. Look at Sir Samuel Baker's expedition, look at five hundred other things, you see abundance of them. The state of the recruiting business at present, is simply analogous to what you see in our trades where the remuneration is not sufficient—it is the country's method of striking. Adventurous and plucky men will not enlist, and they are right in not enlisting; you afford them no inducement to enlist, or if they enlist, they desert. Fortunately for us, soldiers cannot strike, as engineers and ship carpenters, and people of that sort do. The soldier is in a false position in this country. The empire of Britain, widely spread as it is, has been founded and maintained, perhaps indirectly, but not the less exactly, by the bravery of her soldiers. It was by the bravery of our soldiers and sailors that we acquired our position, and it is by that we keep it, and the soldier, as Dr. Adams most properly pointed out, should be honoured and respected. He is in advance of the working man, he is a first-class working man—a man who does more for his country than any other class of men

whatever. But in this country the soldier is looked upon as the dregs of the population, and looking upon him as such, you come to the natural result, and you get much of the dregs of the population for soldiers. If the soldier were treated with justice, and was put in his proper position, I do not think you would have any difficulty in getting men. In all directions injustice meets you in the treatment of the soldier. It is not now as in former days; the barracks are full of newspapers; the men can read, and they contrast everything. Look at a regiment going to India. Before I went to India, my pay was about 19*s.* a-day, and my hospital sergeant had 2*s.* 3*d.* When I went to India my pay became £1,000 a-year. What did my hospital sergeant's become? not a penny more. The men going to India gain nothing by it, except misery. They look round them, and see their Officers with handsome salaries, whilst they, the men, get nothing additional. Do you suppose that all that does not weigh in the men's minds? Formerly, when men went into the Army, they thought at least there was a settled subsistence, and a pension. Now, what is the pension worth? I have submitted the question to the best jury in the world, to that distinguished body of old soldiers the Commissionaires, and they all say to me, "Sir, what is a shilling a-day when you get it." If you look at a shilling a-day through a long vista of 21 years, you get sick of contemplating it, and when you get it, a man cannot live on it, and if a man takes 21 years out of himself, knocking about in the Army, he is good for very little afterwards. My idea in the scheme I have drawn up, is entirely founded upon establishing the certainty of giving the soldier, as a young man, when not more than 30 or 32, the wherewithal to start with in his civil capacity, or if he pleases to transfer himself to the Reserve, and have still further prospects in it. It has been founded upon the old maxim, that gratitude means a lively sense of favours to come, and unless you can have a feeling of that sort in your ranks you will never keep your men. You must apply to self-interest. A man must have prospects, and in this country I conceive you have the finest opportunity of any country in the world for giving your soldiers prospects. You have no end of colonies. You have employment of all sorts which may be made available as the reward of military service. As for giving them pensions that they can live upon, it is an admirable theory, and I quite go with it; but you must conciliate prejudices, and our rulers must be conciliated. Of course if *carte blanche* were given to any committee of experienced Officers, no doubt they would very soon devise a scheme which would fill our ranks with recruits, but what chance should we have of seeing that scheme carried into effect? Our only chance is to devise some scheme that the Government may be prevailed upon to adopt, and that will have the effect of filling our ranks. And in drawing up one, the first thing I set myself to consider was, Why is it that we can always get any number of Officers that we please, but we cannot get soldiers? When you come to contrast the condition of the two, the question resolves itself. The Officer enters the Army as a profession for life; the soldier enters it as a makeshift, and if you can form a scheme which will provide for your men at an early age, and give them the certainty of a moderate sum and a chance of more, you place the soldier on a par with his Officer, and make the Service to the one what it is to the other, a lottery, certainly with many blanks, but with a great many well-deserved prizes. What men like, is a chance. Give them a chance of luck. Luck and fortune have been the two favourite deities of soldiers in all ages of the world, and ever must be. Every man who goes in with the true spirit of a soldier is ready to risk his life, and take his chance of what his luck may send him. But you exclude everything of that sort from your barracks; you make it a dull, miserable scene, a dreary monotony; and what do you hold out to the man? You hold out to him the prospect of getting a penny a-day at some remote period, the very man whose brother is perhaps striking because he does not get 5*s.* 6*d.* a-day. The first thing you must begin by doing is to establish a rational system of remuneration for service; but to enter on that subject at this hour of the night would be entirely out of the question.

Lieutenant-General Sir PERCY DOUGLAS, Baronet: I should not have taken part in this discussion to-night but for the invitation from the Council, because I confess that in view of all that has passed, it is a great pain to me to enter into any discussions on military subjects. But as I have been invited, I shall give expression to the few words that I have to say on this subject, and I may also introduce some

remarks upon the Militia question, because I was for some time an Inspector-General of Militia, and have strong opinions upon this subject.

The first point that strikes me arises out of these tables. I own that the figures before me somewhat surprise me. First of all I will mention what seems to me to be a deficiency. In order to know the value of that table of recruits "inspected," and to gain a correct idea of what sort of men they were *physically* in the aggregate, we should have had stated the number of rejections. In the subsequent part of his paper, the Lecturer stated that he had examined 25,000 recruits and remitted 17,000. I therefore presume the rejections closely approach to 35 per cent., and that is a very unfavourable result indeed of our recruiting operations. Another thing that surprised me was this. After what I have seen of the Prussians, I was not prepared to find that, at the age of 18, our recruits are considerably taller than the German recruits at 20 years of age. I doubt, however, the correctness of that. Judging from my own eye, I think there must be some mistake in it. The appearance of this table is, on one point, gratifying, for it shows that with all our difficulty in recruiting, we still get 45 per cent. of men of very good height, *i.e.*, 5 feet 7 inches. Now before we can place a fair estimate on the value of that table, we ought to know the number of rejections. I will endeavour to divide what I have to say under the two heads mentioned by the Chairman. I think, for instance, that the scheme of short enlistment has failed, and that hence we could not have a Reserve for the Army that we were led to expect; because it stands to reason, that this Reserve can only increase *pro rata* with the number of enlistments, and if we do not get enlistments, we shall not have the Reserve. There are many things that militate against the enlistment. Firstly you cannot buy a man for a soldier for less than he is worth, any more than you can buy anything else. The War Office may exercise their ingenuity,—and there are some remarkably clever men there!—they may shift and shuffle the cards, and make out pretty schemes, but it is impossible to get a good man for less than he is worth. There are now few inducements and some anomalies in the present mode of enlistment which militate greatly against our getting the numbers we desire for the regular Army. First of all, I think we have made a very great mistake in doing away with pensions. I gather that from our recruiters; for wherever I go, I always approach a man who is recruiting and talk to him. The universal testimony is, that it is hopeless to try and get recruits without the restoration of pensions. Whether right or wrong, the conviction remains in my mind that the pension question is at the bottom of our failure. Then there is another thing they have done away with, the bounty. I affirm that a vast number of men enlist into the Army from the want of money (10*s.* it may be), for a good object or for a bad object. The Secretary of State for War has done away with the bounty to the line, but has continued to pay it to the Militia. Here is an anomaly; you are positively at this moment giving a bounty to the Militia and attracting into that force, the very men that we want to pass direct into the regular Army. Then there is another element of failure, namely, the short service. I simply affirm that this is not attractive to the men. The man who enlists, in general wishes to break loose from civil life. We do not know what moves him to do so, whether vice or virtue, or whether it is from no reason at all; but still he does break loose from civil life and he has a very natural wish to arrive at a pension. But there are other inducements wanting to attract men. When the great changes were recently discussed in Parliament, if I am not very much mistaken, some of our prominent men vaunted an assimilation to the Prussian system. What a delusion that was! and I am afraid it was intended as a snare. But it is nothing to vaunt of. What similitude is there between our present system and the Prussian system which embraces all classes by forced service, whilst we continue to enlist from one class solely by voluntary service? Where is the likeness? It was hoped to tempt into the Army what they called a better class of men, the possibility of which I very much doubt. It was said "Now is the time! Purchase is done away with. Everything will go by merit." It was like telling a French soldier that he carries in his knapsack the "*bâton de maréchal.*" No such thing. Why the very moment they did away with purchase, they took away the highest and first motive for a poor man of a superior class in life to enter the Army; for what was his object in entering the Army? He said to himself, "If by good conduct I rise to the rank of an Officer, and for 25 years fulfil my

"duty fairly, what shall I gain? I shall not be turned off into the world without "some permanent provision for my family, for the custom of the service and the "law tacitly sanctions my retiring on half- or full-pay, and with a very good "bonus into the bargain." I agree with the last speaker that we have had people administering our military affairs who are totally unacquainted with military matters, who know not the needs and requirements of the soldier, and know not the habits nor sentiments of the Army one bit.

Those are partly the reasons why this recruitment has failed; and now I will say a few words on the reserve. It is no use discussing the matter if we cannot get the men for a Reserve for the Army. What, then, can we substitute for this Reserve? Every man has his hobby, and I have had a hobby for many years, and which has taken its rise in my knowledge of the Militia. I say if you cannot get Reserve men for the Army, then the next best thing you can have for the defence of your country is this—to have a real Army of Reserves, and there you have it almost cut and dried in your Militia. All that you have to pay, is the difference between the actual cost of the Militia and the embodiment of portions of it in succession 18 months or two years at a time, so that you shall always have a large body of infantry and garrison artillery prepared to be literally, as far as these two arms are concerned, an Army of Reserve, and there (in the Militia) if we cannot get reserve men for the Army, is where you can get an Army of Reserve. I do not say that they are to serve by compulsion in any foreign climes, but knowing, as I think I do, the sentiments and *morale* of the Militia, I am as convinced as I stand here that if, as I have proposed, and as I have written often in official and non-official papers, the Government will thus embody in succession portions of the Militia and create an Army of Reserve, if our country got into difficulties in whatever part of the world, you would find these Militia regiments would nobly and loyally offer to go wherever any other portion of the regular Army went. It is, as the lecturer remarked, not only the numbers of men, but the physical capacities of the men, that have to be considered. It is quite true that very often low height with us is only another expression for minor age. A boy of 16 or 17, pretty well developed, comes forward; he has a certain height, and he calls himself 18, and perhaps looks 18, and there is the great perplexity, that in times of difficulty we may have in our Army numbers of these recruits, fine fellows as boys, but perfectly useless as being under the age and not possessing the physical capacities of men. This is one of the prime recommendations for embodying in their turn great portions of the Militia, because in the Militia they have a great number of men of ascertained ages, and vast numbers, as heretofore, would in time of war join the regular Army. There is no doubt that in the Militia there are superior inducements for the men to enlist in peace; they rapidly accommodate themselves to military habits and discipline, and you have in the militia regiments not only a vast reserve of men for the Army of the proper age, of the proper physical capacities, but the infantry and artillery of an Army of Reserve. I do sincerely hope and trust that this short-service scheme for a Reserve for the Army may not fail, as I fear it will do, however. God knows how urgently I wish it were otherwise, and I am sure every military man here will go with me in really wishing that the plans of the War Office should have the most ample success; but I fear that we shall not reap what they expect, but that we shall gather in what we have sown. I am convinced, for my own part, and I have thought a great deal upon the subject, that it is utterly hopeless to pursue our present plan of enlistment for getting up a Reserve for the Army. Short and long services for pension should be optional, but the latter should be most largely encouraged; and men should not be removed from one regiment to another against their consent, and they should receive a bounty for consenting thereto.

Lieut.-Colonel EVELYN, 1st Royal Surrey Militia: The question whether the maintenance of an efficient Army is compatible with the system of short service and Reserve is one no doubt that admits of a vast difference of opinion, but I think every one agrees in this, that if it is to be attempted, the advantages to be held out to volunteers, must be increased. It is evident that the pay and the bounties, such as they are, the prospects of the soldier, are not at present sufficient to attract an adequate number of recruits. How is this to be attained? It resolves itself into a question of money, and money can only be given in three ways. It may be given

before service in the shape of bounty; it may be given during service in the shape of increased pay; it may be given after service, as gratuity or pension on discharge. Now the system of bounties has been tried. We have given vast sums of money during war; the more men we required, the more we increased their bounty and the greater number of desertions we obtained. It has been a failure. We have increased the pay of the soldiers, and have given them free rations, and I believe that has been a good thing, but I do not think we could go much further in that direction, for drunkenness is very rife in the Army, and I fear it would increase if the pay was much further increased. It then only remains to give it after service in the shape of pension. How is this to be done in short service? It is impossible to make a man a pensioner after six years' service. I do not mean to agitate the question whether it would not be better to enlist men for 21 years or for unlimited service. I wish to consider what, instead of a pension, can be given to a man after a limited period of service. It was some years ago since I first recommended publicly a system of deferred pay, on which we have heard many strictures to-night, and some months ago I renewed the subject in a published letter in the *Times*, that caused some remarks, and which I hope is vegetating in the public mind, and will bring forth fruit hereafter, for I am perfectly certain that nothing but that will meet the difficulty—a system of reserved pay to be given to men on completing their service. I feel pretty confident that in the course of five or six years that system will be at least tried; it seems to me the only plan by which anything approaching to a pension can be given with short service. And if anything is to be given, it should certainly be given in exact proportion to a man's good service, in other words, that each day's good service should carry with it a certain amount of reserved pay. The plan I proposed was very different to that of which Dr. Adams gives us a sketch in many important particulars, and was I think far better in many respects, but perhaps I had better not trouble you with it on this occasion. With regard to the system of the Militia bounty, I think there are many fancies rife about that system, and Sir Percy Douglas will pardon me for saying I did not quite agree with some of the remarks he made just now, although I have the highest possible respect for his opinion on Militia matters generally. The Secretary for War the other day, I believe, stopped the bounty on enlistment for the Army; he also wished to stop it for the Militia, and we were surprised one fine morning at the receipt of an extraordinary circular, telling us that in future we were not to give the men the usual bounty of 10*s*. when they offered themselves for enrolment. We had recently been told to recruit as much as we possible could, and to get up the Militia in a short time; then we receive a circular to tell us we are not to give the men 10*s*. on enrolment, to give them nothing in fact without special authority. It amounted to this, that a lad in his fustians or rags was supposed to go to the Militia sergeant and say to him "I want to be enrolled," was to strip, to be subject to a surgical examination, to be taken before a magistrate and to swear this, that and the other, and then to be sent away without getting one shilling to return to his home. Of course the circular, as any one practically experienced in the Militia would know, amounted to an order to discontinue recruiting, and I believe for two months not a single Militia recruit was enrolled in England. There might be one here and there, but there were not any in my county. It is a pity, I really think, under these circumstances, that the gentlemen in the War Office do not take the trouble to consult some one with practical experience. Officers of the regular Army cannot be supposed to know much about the Militia, but certainly no Militia Officer would have hesitated for a moment to say that that would be the effect of that circular. The question of recruiting for the Militia is very intimately bound up with that of recruiting for the Army, and I want now to come to the point I mentioned before. It seems to be said that it is hard the Militia should receive a bounty while the Army does not, and I saw a letter in one of the morning papers the other day from an old soldier who said, "The Militiaman gets a guinea a year, "and we poor fellows get nothing." But then we must remember that the Militiaman not only serves his 27 or his 56 days, but he enters into an engagement binding himself to serve for any 56 days in the course of the year in which he may be required, and these 56 days may be broken up into two terms; so that it is not the mere pay for the days in which he serves; it is not the mere loss of time during the

term he is out on training, but the great thing is that he is unable to accept any regular employment whatever, but is bound to be at the call of his Officers during the whole year. His case very much resembles that of the Naval Reserve, who get a capital annual retaining fee. The Militiaman gets a bounty—and he ought to get a bounty on enrolment—say of 10s.; and that is the only bounty: the training bounty should properly be called an annual fee. I believe that is the term used in the Naval Reserve. When I was in the Shetland Islands two or three years ago, I was informed the men in the Naval Reserve got sufficient every year to pay the rent of their small farms. They are obliged to hold themselves in readiness, I presume, to go through their drill at whatever time is most convenient to the Government, and consequently are prevented from taking regular work. It is very unfair, therefore, to say that the Militiaman gets a bounty that he does not deserve. He does deserve it, for he is under great restrictions, and cannot take regular employment. He never can go far from home at any time. He may be called out in April or in November or December; he may be embodied at any time of the year, and I think that the pound is the very least that can be given him for that obligation.

Sir PERCY DOUGLAS: I am rather surprised at the gallant Colonel differing from me, because the tendency of what he has said is entirely to agree with me. It appears, after all, that the Militiaman does get the 10s. when he joins, and that he does get the £1; and as to the obligations of the Militia, surely they are not greater than the obligations of the men of the Line. The man in the regular Army has to enlist for twelve years, and to go anywhere and everywhere, with the chance of being shot into the bargain. Of the two, I should think he is the more entitled to the bounty. We have not to judge here what may be right or what may be wrong. We have to consult the habits of the people; and, as I say, taking the old recruiting sergeant and so forth, the answers we get are, that the men like the bounty, and if they cannot get it in the Line, they can get it in the Militia; and hence it is that so many go into the Militia.

Major WETHERED, Paymaster, R.A.: This, sir, is a subject of vast importance. It certainly does appear that we are in a lamentable state, seeing that we are practically without any Reserve capable of being converted into a fighting force either for offensive or defensive purposes, and that we cannot even keep up our diminutive regular Army to its required strength, and further, we are assured by the Lecturer that the recruits we get in the infantry are "not up to the standard of our race." The next question is, Can we retain the men that we do get? I fear this must be also answered in the negative. We find that there are 45 per cent. of rejections. I wonder how many of those passed into the service have, after joining their regiments, been discharged as unfit. With reference to the Royal Artillery, I can give you a statement of facts. In the year 1873 there were passed into the service 3,479 men. During the same period 1,358 men deserted, and 386 purchased their discharge, making a total of 1,744, or more than half the number raised, who leave the service of their own accord prematurely, either by desertion with all the penalties attached to it, or by payment for discharge. And when we take into account the average death rate, as well as the ordinary discharges in due course, it cannot be wondered that the regiment at the close of the year stood 1,000 below its numbers. In the Royal Artillery the attractions are greater certainly than they are in the Line, and this instance proves that when we get men into the Service there is not sufficient attraction to keep them in it. It certainly does appear to me that it was a very great mistake ever to have given up the system of long service, unless we were prepared to have gone in for compulsory service. I do not see, in the position we are in in this country, how it is possible to form a Reserve, or to keep up an efficient force on the short-service principle. We must adopt one of two courses. We must either resort to compulsory service for short periods, or hold out such inducements to the soldier as will tempt men to enter the Service for the sake of the benefits really to be derived. I cannot understand how any man of the least thought would ever think of entering the Army under the conditions offered to him at present. Take, for instance, a lad of 18—very often, through our faulty way of recruiting, not more than 16 or 17. We expect that lad to enlist for six years, for a shilling a-day, three-quarters of a pound of meat, and a pound of bread, when he sees his fellow lad getting in the labour market two or three shillings a-

day, and enjoying an amount of freedom and independence. We take this man during the years when he ought to be learning some handicraft, and teach him nothing but the roving, restless life of the soldier, give him sevenpence or eightpence a-day as clear balance. He spends it—in what? Generally in drink. It goes to the canteen. I maintain, when we turn that man out of our service after six years, instead of having improved him, we have made him a more useless member of society than he was when he enlisted. He is unfit to learn any trade or occupation, and we have given him habits that certainly are not an improvement to people in his class of life, and then we expect to pass this man into the Reserve at fourpence a-day. It is simply absurd. What can be expected? We cannot get men; and, when we have got them, they are inferior. Then they desert; and yet we expect to form an Army of Reserve on this principle. It is quite impossible. If it were possible to combine the short service with some system under which every man might learn a trade, and thus be fitted for after occupation, we might expect to do some good: at present it is utterly hopeless to expect to form an Army of Reserve in the manner we are attempting to do it, and from the materials we are making use of. I certainly would commend to those in authority a portion of the title of the lecture, viz., "from a military point of view." Unfortunately, political and civilian views prevail, and the military point of view is seldom considered. We see warrant after warrant framed, always exhibiting on their faces an ignorance of the sympathies and feelings of military men. The recent pay-warrant was to have done a great deal; but what did it amount to? A mere nothing. If they were not prepared to have given a full free ration, not only of bread and meat, but also of grocery, they had better have left the old plan in existence. It would have been much better to have given the men another 1½*d.* or 2*d.* a-day in addition to their pay, than to have gone into a kind of half-measure of this sort. It would have given much greater satisfaction to the men. If we look at the different rates of pay, it is a mere minimum of increase; but with that minimum of increase there are certain sore points opened up. For instance, the increase, as a rule, is about a halfpenny; that is to say, deducting the ordinary ration from the old rate of pay, and comparing it with the new rate, the increase has been about a halfpenny. That is the case with the privates; though in some cases it has gone as far as 1½*d.*, especially in the Line; because (here appeared to be the difficulty) it was stated that no man was to have less than a shilling a-day, and that was almost impossible to be carried out. So to make it appear on the scale that every man got a shilling, he had given him his bread and meat, but not his grocery. In the Line 3½*d.*, and in the Artillery 5½*d.* must be deducted from the net pay now shown to arrive at the clear balance. When it came to the private in the Line, his pay was so small before, that, to make it up to the shilling they had to give him an increase of 1½*d.* Now, if it was important to give a private that increase, it surely was important not to diminish the advance of pay on promotion; but I find that a man rising in the Line from the position of private to corporal would get a penny a-day less increase than he had before. He only gets an advance of an actual 3*d.* in his pay, and so through all the grades; so that, instead of increasing the advantages of Non-commissioned Officers, the reverse has been the case, and they have been diminished. Then we have cut off the pension. Of course men always look forward to a pension. Under the 21 years' service system, men and Officers were bound together for long periods, their interests were mutual, and, in fact, a regiment was very like a family. Some of the best recruits that we got were soldiers' sons. Now, however, we have lost all that; the family feeling has gone; men care little for their Officers, and the Officers as little for their men, who they know will only stop in the regiment for a short time. There is a constant uncertainty as to changes, and the Army is broken up, as far as that feeling goes, in every possible way. Then, again, there is another sore point. A man goes on furlough; he goes back to his part of the world, and he ought to put in an appearance of respectability. Instead of diminishing his pay on that occasion they should rather increase it. But here we find that they diminish his pay, for, whereas they give him a free ration, which costs the Government 7½*d.*, while he is in barracks, when the man goes on furlough they stop his ration and give him only 2*d.* in lieu of this 7½*d.*

Sir PERCY DOUGLAS: They have taken away the 2*d.* on furlough.

Major WETHERED: No; they could not do that; it is bad enough as it is. A soldier says, for instance, "If I go on pass for a month, my duty is performed by "my comrades. Why should the Government desire to save upon the rations which "I do not eat? That ration costs them 7½*d.*, but now I am going away they only "give me 2*d.* for it." In hospital a man loses a penny more than he did formerly. There are many little hardships of this kind which do not come to the surface. Under the old rule, when the man went into hospital, the ration might be drawn for the benefit of his wife. In the same way, when he went on short pass, he could draw a ration, and his wife would subsist on it; but now he cannot do it. If he goes into hospital, he has a mere pittance of balance left; his wife gets no ration. If he goes on furlough his ration is stopped, and he goes away with this minimum of pay. All these are sore points, which, if the warrant had been framed "from a military point of view," would have been avoided. Then again sufficient inducements are not offered to the soldier. There are not enough posts of advancement in his profession. I maintain that the non-commissioned grades are not what they should be: the men should be in a higher and better position. Again, many posts might be created. What can be more disreputable than our recruiting system? You take some of the smartest men in a regiment and send them to certain towns. They ally themselves to certain public-houses, as though the gin palace and the Army were inseparably connected. They pick up the refuse of the town, and, under the influence of drink very often, induce the men to take the shilling. That is a gross mistake. Then, the whole system demoralises the Non-commissioned Officers and induces them to teach deception; for they will tell a lad of 16 to say he is 18 or 19 for the purpose of passing, so that they may get their rewards. There is no occasion for this. Surely we might get some kind of general agency throughout the country. Why not have, in certain towns, your recruiting agent—a man who, himself still in the service on full-pay, would be an advertisement in his own person—a man who had risen from the ranks to a good position, and was comfortably located. He would be looked up to by the people in the villages round about, and would lead them to say, "The Army is a good thing. Look at So-and-So, what a nice position he holds!" I say if you were to turn out men in that way you would offer an inducement to the youth of the country to come into the Army. Now, however, the reverse is the case. Take our six years' service. The men, after leaving the Army, would go to various localities to be localised on this 4*d.* a-day. Would there be anything in those men to tempt the youth of the country to follow their example? I consider that such Reserve men should have written on their backs the caution to avoid the Army. Certainly it is a painful thing to see a man with medals on his breast a pauper in our poorhouses; but that has been the case over and over again. You meet with men who have shed their blood on the plains of Waterloo ending their days as paupers. That is, I think, a great scandal. The other day, in Scotland, I met a fine old fellow, 80 years of age, and on talking to him found that he had been all through the Peninsular War. He had left the service after being in it seven years, had struggled on and laboured to sustain himself; but he was now getting too old, and had no means of support, and there was nothing for him but the workhouse. The country ought not to allow a thing of that kind to happen to a man who has gone through hard service. There ought to be some provision to keep him from such extremities. In this case, where the old feeling of *esprit de corps* prevailed, I mentioned the matter to the regiment in which the man formerly served, namely, the Royal Artillery; and, in a very few days, sufficient money was raised in that regiment to keep the old man for two years on 5*s.* a-week. The Officers themselves subscribed to keep a man of their own corps out of the poorhouse. I think the prospective advantages could be improved, and the point to be considered is whether we are to return to the long service holding out inducements, or whether we are to continue the short service, holding out some greater advantages. I really do not see how the present scheme can possibly be successful, and I do not know how pressure is to be put upon the Government to induce them to set about adopting some other plan. Certainly, if they were to form a Committee of Officers capable of giving an opinion, we might arrive at some tangible method of going to work. At present, we all seem to be in utter darkness.

Colonel LYONS, Assistant-Adjutant-General, Recruiting Staff: From my posi-

tion in London as Inspecting Field Officer of the Recruits, which I have held for the last three years, I hope to be able to give you some information respecting recruiting for the regular Army, and the desertion of the recruits. Dr. Adams has pretty clearly set forth to you the *physique* of recruits; but after all, when we come to weigh the thing, it is all in a nutshell It is a matter of £ *s. d.* I have been some 45 years in the service, and in my day, whilst I was in Ireland, the soldier could buy the best meat in the market at from 2*d.* to 2½*d.* a lb.; the best bread at 1*d.* a-lb.; 14 lbs. of potatoes for a penny; the best milk at 1*d.* a quart, salmon at 1*d.* a-pound, and all that. He was probably a labourer, digging turf or potatoes all day long, and therefore by enlisting in the Army, his condition was considerably altered for the better. I need not mention to you that his money went much farther than it does in the present day. In addition to that he had certain rights. On completing 14 years' service, he had an additional 2*d.* a-day, and a soldier in those days would say, "You may flog me, or do what you like, but you cannot take my extra pay from me." Compare that with the present day. There is additional pay; but when you take the extra expense of everything into account, the soldier has not as much money to devote to his own purposes as he had in those days. There was the further addition that, if he met with an accident on duty, if his service was short, he got a certain amount of compensation, and he was certain, when he completed his 21 years, to get a good pension of a shilling a-day. The consequence was, in those days, the service being so attractive, and men so plentiful, you had any number of splendid recruits at command. I, myself, as adjutant of the regiment, turned hundreds away from the barrack gate who did not come up to the height of 5 ft. 8 in. or 9 in. I would not take them, because we had a choice in those times, and why? Because it was an advantage to enter the Army. Since then, there has been a considerable alteration. I will not attempt to discuss the suggestion of Dr. Adams that, as a nation, we have fallen off physically, for I do not understand it. I think now, as well as then, that if you pay the men according to the present market, you will get the same size. If size is to be taken as an advantage, you will get any standard you want by paying for it. At present we have to take recruits per regulation, 33 inches chest, 5 ft. 5 in. in height, and any one of experience knows that means simply a boy or a lad. You may range from 18 up to 25 years of age. Now, I need not remark that a man of 33 inches of chest and 5 ft. 5 in. in height, at 25 years of age, is scarcely likely to make a good soldier as far as appearance goes, though he might fight well enough. Therefore, the younger you get them at 33 inches chest and 5 ft. 5 in. in height, the more likely they are to be good-sized men when they attain a certain age, say 21 or 22. At the present day, wages being so high—from 3*s.* to 4*s.* a-day for a labourer—the class of men that hitherto, as we all know, have formed the splendid infantry soldier, viz., the agricultural labourer, will not come to you for a shilling a-day. If we cannot get them, what are we to take? I am speaking particularly here, in London; but I believe it is the same throughout the country. You must take anything that offers, according to regulation. Now, I profess to be as good a judge of what will make a soldier as any man in the British service or out of it; but I am bound, by regulation, to pass these men, if considered physically fit by the surgeon, if they come up to the standard of regulation; but they are not the men I should myself, if I commanded a regiment, wish to take into it. You take these men? Why? Because you cannot help it. The whole thing is as plain as A B C. The whole discussion this evening amounts to one thing. Changes have taken place from the days I have just mentioned to you of cheap rations and of a good pension to look forward to. To what? Men come forward now. Perhaps many have a great desire to join the service, because there really is as great a military spirit extant at the present day as ever there was in the country. I have no doubt of that. Men enter the service readily, and, I must say, were the conditions six times worse than they are at present, you would get a certain number of men and a certain class of men to enlist; but then comes the question, Are they the sort you want? You get them, as I said just now. They enlist according to the conditions. We have no choice. We are told that our service is a voluntary service. Now, it has always been a puzzle to me to know what the meaning of a voluntary service is. The voluntary part begins and ends in the Act of Enlistment. No man can force a man in this country to enlist; but if he enlists, there he is—he must abide by whatever

the conditions of the service are. A fine youth comes and tells you he is 18; probably he is not so. He enlists for six years with the colours, as it is called, with the understanding that at the expiration of that term, he is to join the Army of Reserve for six years more. With all due deference to the gentleman who has spoken about the dissipations of recruiting and of public-houses, and all the rest of it, what is the recruiter to do? The recruit asks the recruiting sergeant "What is the Army of Reserve?" He says, "I do not know. I suppose it is an Army at home, and that you get 4*d*. a-day for doing nothing." Perhaps to some it sounds very well, but when the man joins his regiment, and begins to talk the thing over, he says to himself, I like my regiment, but at the end of six years I shall be turned about my business; I cannot remain in the service. What will the effect of that be? He enlists probably at the age of 17 or 18. At the expiration of six years he is only 24. According to the Regulations of the Service, men are taken up to 25. He enlists originally as John Jones. He is supposed to be in the Army of Reserve, and he comes back to the service as Joe Smith, and goes for six years more. Well, your Reserve man is lost, of course. In the cavalry and the artillery they enlist for 12 years, and they have nothing to do with the Army of Reserve, but are supposed to take their discharge. I must say, from my experience in London, that no more satisfactory class of recruit can be obtained in the world than the cavalry recruits in London, whether you judge them by their stamina, or any way you please. I could show any gentleman here these recruits, if they liked to come over to the barracks. On some days we have as many as from 12 to 20 men, 5 ft. 8 in. to 5 ft. 11 in. for the cavalry, with 36 or 40 in. chests—fine, splendid fellows. Of course the men for the light cavalry are rather inferior in size.

The CHAIRMAN: Do you think the preference for the cavalry regiments is due to the length of service?

Colonel LYONS: The men I am speaking of as enlisting for the cavalry are, many of them, educated men. Many of them are gentlemen who have failed at the examinations at Woolwich, or for the Civil Service, and there are many—I could mention certain names—who enter at the present day with the view of obtaining commissions from the ranks. I will confine myself, first, to the description of the recruits. When you hear it said that the London recruit is this and that, reference is generally made to the infantry recruit as being inferior, whereas, if you take the recruits generally in London, they are the finest recruits you obtain in the country for the cavalry service. The recruits for the cavalry are of a superior class. They are gentlemen of education, clerks, and so forth, who cannot turn to the pick-axe and shovel work with the agricultural labourers, who are required for infantry. Your agricultural labourer comes forward and says, "Halloa, sergeant, what is the pay; what is the bounty?" He replies, "No bounty; a shilling a-day." "Oh, no, that won't "do: come, I can get 3*s*. or 4*s*. a-day." Pick-axe and shovel go on his shoulder, and off he marches. An educated man cannot do this, and consequently he enters the cavalry service. One of the finest regiments in the service, the 6th Carabineer Dragoon Guards, is nearly all composed of recruits raised in London, and hundreds of them have passed under my own observation, as I have approved of 10,000 recruits within the last three years. Speaking of the advantages of the service, the recruits enlist in London readily with very few desertions. They go and join their regiment, and then they begin to inquire into matters, and they find, comparatively speaking, that they have made rather a bad bargain of it. Say that it is summer time and harvest is going on, they consider sometimes like this perhaps, "We are only getting a shilling "a-day, and at the end of six years shall be sent about our business." Well, what is desertion? Oh, nothing. Get three or four shillings a-day to go off for a lark. If a Captain of a company finds fault with a man on parade, or he does not like the station, he deserts. He has no dread of punishment, no letter D, and I candidly say I know I am passing deserters as recruits every day in the week. In former days when a man was discharged on account of bad character, there were the letters "B.C.;" but now they are discharged from the 50th regiment on one day, and are enlisted in the 51st the next. I believe even the Guards and the regiment to which our gallant Chairman belongs, is not exempt from that. I speak in a homely way of these things, I am not entering into politics. Politics have nothing to do with it. We are all uniting with one feeling, and our object is to give our opinions for the

benefit of the service that I have always liked and will like. Let them alter it as much they will, I will like it to the last. We have a small Army, and we ought to have a very good one. If a man likes to enlist, let him enlist for a limited period. At one time I was opposed to that myself, when I was Adjutant of one of the finest and smartest regiments in the British service, the 5th Fusiliers. I know what the old style of soldier was, and what the soldier ought to be in every sense. Those days are gone past, but there is a way in my opinion of remedying the thing at present. If in this country enlistments are voluntary, why not meet the men as far as you can. Six years' enlistment is a mistake for this reason. Even a man who likes the service, from the very fact of at the expiration of six years being able to take his discharge, will take it—why? not that he dislikes his regiment, but simply that he can have a change. It would be far better to prolong the term to ten years. Instead of keeping the fixed price for discharge as high as at present—£20—why not reduce it? Put it within a man's means if he dislikes the service to purchase himself out; thus if he enlisted for ten years, for the first five years, let the price of his discharge be £10, after that up to the completion of his time £5. At the expiration of his ten years give him the right—at present he has no rights—of either taking his discharge or re-engaging if physically fit, and go on for 11 years more. The effect of that would be that every man on entering the service would have the pleasant feeling that if he liked his regiment and the service, he could go on and serve his time, and at the expiration, would be entitled to a fair and reasonable pension. Having served 21 years in the same regiment which I left ten years ago, I found not one man out of 20, lived long enough, through the ordinary casualties of the service, to claim his pension. Nevertheless the effect was good, because it cheered every man to look forward to the end of his days, when instead of going to the workhouse he would have his pension to live on. Then again, as has been remarked, the Non-commissioned Officers in the British service, particularly the sergeants, are underpaid. I am sure every Officer will agree with me that they are about the most useful and essential men to maintain the order of a company, its discipline and so forth, of any class. What has occurred in my own experience? As Adjutant of a regiment, I was most particular in the instruction of the men, in seeing that they attended school, in getting them on for Non-commissioned Officers and so forth. Those men whom I had almost forced to attend school, when they came to the expiration of the ten years' service found that they were superior men to what they were when they entered the service. The result was, they found such inducements in civil life, in the Mauritius and elsewhere, that instead of reaping the benefit, when I became a Field Officer, and part of the time commanded my regiment, of retaining the services of those educated men, they left the service and entered civil life, receiving better pay. I could not blame them for doing so. By raising the pay of the different grades of Non-commissioned Officers you have lots of men in civil life who are educated and who would be glad to enter the service. They would be glad to come in with the object of arriving at the ranks of sergeant, quartermaster-sergeant, or sergeant-major, for 5*s.* a-day, and a higher rate of retirement. Educated men, now that purchase is abolished, are entering the ranks with a view of getting commissions. They cannot all obtain them, and the consequence will be, that you will have a number of educated and discontented men in the ranks. With reference to the Volunteers, we find that many of the corps are dwindling down, and the Officers tell you the reason is, that the examinations are so strict, that men do not care to undergo them. My notion is that it is too heavy for their pockets. Those Volunteers who cannot support themselves might be local Militia, and supported by the State. The Officers and everybody else would be relieved. You could have an extensive, active, and local Militia and would be able to keep up the supply.

Captain COLOMB, late R.M.A.: With regard to what may be called the degeneracy of the *physique* of the Army, I do not think there are any reliable statistics to show whether the actual *physique* of the nation has deteriorated in the same degree. We should be glad to have information on this point, which is a very important one. Figures have been given by Dr. Adams to show how it has diminished in the Army, but there is nothing to show whether the population generally has deteriorated in the same degree. I think there is reason to believe that it has, for the very reason the Lecturer has given. We know that the agricultural population of the country

has very much decreased, while the town population has very much increased. With regard to one point which has been alluded to by various speakers respecting the increase of advantages which should be offered to Non-commissioned Officers, no doubt there is a great deal of good in it, but I think also, under the present conditions of the Army, a considerable amount of harm may be done in carrying out that principle, and for this reason, there is a very small margin between the advantages you offer a Sub-Lieutenant and the advantages you offer a sergeant, and under the new scheme each man is to be a professional man,—one is a professional Officer, the other a professional Non-commissioned Officer; therefore you bring the lower grade of Officers too near to the upper grade of Commissioned Officers. I think, under the new system, where you merely adopt the military code to enforce discipline instead of the old feudal feeling that existed between Officers and men, you must make some allowance for the change of system. With regard to the general question, it is complex, and requires a considerable amount of thought. It is almost impossible to keep on the subject and off your hobby. The first point is, what inducement can you offer under the voluntary system? The material point is to settle what is the force you require. It is not merely a question of £ *s. d.*, because if your force passes a certain margin, it would become impossible financially for any country to keep it up; therefore it is not a matter that can be summed up in the three words, £ *s. d.* Then comes the question, what part of the Army is to be standing, and what is to be Reserve, and before you can really approach the question of the Army at all, you must settle what is to be the military policy of your country. Even supposing it to be a purely defensive policy, still it is a question of numbers, and it is a question of numbers that cannot be limited to a very small area, such as we are accustomed to hear it limited to, that is the area of the United Kingdom. The table exhibited by Dr. Adams shows one very remarkable fact. By it we see that the proportion contributed by the colonies was 6 per 1,000 in 1860, and in 1872 it was very nearly 7 per 1,000. Now the inducements to enlist in the colonies in 1860 were very much greater than they were in 1872, because you had a greater number of recruits and a larger force.

Dr. Adams: These are recruits born in the colonies, but not enlisted there. There are no recruiters in the colonies.

Captain Colomb: I am aware that there are no recruiters in the colonies, but I should like to ask whether that is purely limited to the West India regiments?

Dr. Adams: No; that is probably in Canada,—Canadians enlisting in regiments in Canada.

Captain Colomb: I wish to point out that the colonies are an increasing element of the recruiting area.

Colonel Lyons: We have had no recruits from the colonies since 1865.

Captain Colomb: I merely repeat that the table shows that we have an area of recruiting which has increased. What we are dealing with now, is the present state of the Army, and it must be remembered in estimating your force, supposing even that you meant it to be simply a defensive force, you have an enormous area of the world to defend, therefore you come to an enormous force, and that being the case, you cannot put the question aside by saying it is a question of £ *s. d.*

Sir Percy Douglas: Whatever your numbers are, you cannot get the man for less than he is worth.

Captain Colomb: I am perfectly aware of that, but I am also perfectly aware that you cannot maintain a sufficient force in the standing Army, and therefore you have to provide a Reserve. More than that, you have to bear this in mind, that a large proportion of your Army cannot be a short-service Army. There are your cavalry, your artillery, and your engineers.

Colonel Lyons: What do you mean by "short service?"

Captain Colomb: I mean it in the ordinary acceptation of the term. We have had "long service," 21 years; we have now "short service," which is the six years' enlistment. To resume, we have three branches in the Army, and of those three, only one can possibly be called a short service. You cannot educate and train an artilleryman, and turn him back to civil life; it would be false policy to do it. The more time it takes to train a man to fill a certain position, the more valuable that man is to the country, and the longer should the country retain his ser-

vices. If you turn to the Recruiting Commissioners' Reports, you will find it takes them two and a-half years to make a gunner, and it has been said, that cavalry soldiers in the field, under two years' service, are a hindrance. Therefore if it takes a long time to train a man, when you have him, so long as he is physically fit, you are bound to keep him, and if you wear that man out in the service, you are bound to provide for him. Therefore in these branches, you cannot possibly apply the short service. But I believe, that within certain bounds and restrictions, the short-service principle can be applied to the infantry of the line, and the question of what you are going to offer the man at the termination of his service is not a question that can be looked at from a military point of view, but purely from a commercial point of view, and what you have to offer that man so as to compensate him for the loss of time in learning a profession, by his having lost so many years in the Army. That being the case, to get at what should be given to the man after a certain period of service, you must first fix your period of service from a military point of view. Then you must ascertain what are the average wages in civil life of the man when he enlisted, and what are the average wages of the man at the period of life when he is discharged. You must not only give him the balance, but something for continuing liable to return to the Army. Therefore I think it is a commercial question with regard to the trade of the country and to the labour of the country, and you have, every year, to deal with skilled labour more than agricultural labour. There is only one thing that I wish to remark in conclusion. We have heard a great deal of "measures not men," and certainly as regards the Army now, it has been given "measures," and it has not been given "men."

Mr. A. Hay Hill: I feel that as it is late, I must not intrude upon you for long, but I am rather glad to support the view taken by Colonel Lyons, because whether it be called £ *s. d.*, or whether it be called the law of supply and demand, this is simply a great economic question, that is to say, whether the men can be obtained in the present condition of the labour-market. You may either call it "supply and demand," or you may call it a question of £ *s. d.* I would submit to this meeting that it is purely a trade question, and that it is not a professional question, and the sooner it is removed from purely professional considerations, the sooner will it be reduced to its real economic proportions. It seems to me it has been assumed for a long time, that the agricultural labourer was the true typical soldier; but according to the theory and the experience of Col. Lyons, I think you will see that the agricultural labourer, as a soldier, has simply been the natural product of the condition of the labour-market tending towards the Army, because he was the poorest paid worker of the labour-market. A short time since, when the great iron industry of Cleveland sprang up, it was contended that the men that had moulded iron in the past were not to be had, because the particular class of men from whom the iron-moulders and the iron workers came, were not at once to be had. But it was very soon proved that the law of supply and demand produced the men to work the iron, and I would submit that if the advantages of the Army were as well known as are the advantages of the well-paid departments of labour, assuming the Army to be better paid, that the men would follow the guns and would follow the recruiting sergeant. You find that in London, as Colonel Lyons has told you, a very considerable number of men are able to be obtained. They are now able to be obtained from the clerk population, and I have not heard it asserted that if the clerk is put into good muscular condition, he is not equally fit to be an infantry soldier as he is fit to be a cavalry soldier. Therefore there may still be a very considerable body of persons to be drawn, who will turn out, not the ignorant and useless soldier, for two years, but the man who will easily learn what he has to learn; because it is only, after all, something of the old trades-union-idea to assume that a man cannot learn a business under a certain time. If you introduce into a trade a professional man, or a man in the habit of applying scientific principles to anything, he very soon learns his business, and I think it would be found if a more intelligent class of men were invited into the Army, under fairer conditions, that the labour-market would very soon supply the men. There is one point which has been raised here to-day by Dr. Cameron, with respect to the accumulation of money in the hands of soldiers. I would submit to this meeting that any arrangement under which a large number of men had a lump sum at a comparatively early age in their career, would be most disastrous, not only to the Army,

but to the men themselves, because I think you will find that the men who in one calling accumulate a certain sum to carry into another calling, are neither good men in the first calling nor good men in the second. You will find, as a rule, that the men who in domestic circles save a little money usually end in keeping a public-house, and I think that if soldiers on the same principle at the age of 23, or probably something under that, had what might be £20, they would think it sufficient to play with the money, and consider what they would embark it in, and whilst they were fiddling with the money, they would lose all the attributes which constitute the hard-working man, who is going to make his trade his life profession. It will be seen that the whole tendency of modern thought is against the system of pensions, and it will ultimately be found that the Army, like every other trade, will have to serve for its salary, and will have to do the best with its salary, and to make the most of that salary in the way of provision for future time. But assuming for the moment that Colonel Lyons' view is correct, and that a man had more option as to how he went in and how he came out, I think you would find, with the present growth of co-operative trade, that there would be a large number of positions entirely apart from patronage or official precedence growing up for the class of men that would come out of the Army, namely, men accustomed to method, accustomed to drill, and not desirous themselves of necessarily becoming masters. That is the particular class of men which the labour-market now requires, and I find from daily experience with large quantities of labour, that the young man of the present is not content to learn his trade, but he must needs be continually trying a number of trades, until he finds no instrument in the labour-market suits him at all. If a large number of men were during their early career in the Army trained in habits of discipline and method, they would be serviceable men, not in the sense in which Commissionaires are serviceable, because my own experience proves that in many ways they are the most unserviceable men in London, but men who have learned methods and habits of life, which they would be prepared to carry into any trade they might in after life learn for themselves.

The CHAIRMAN: There are so many other gentlemen anxious to take part in this discussion, that I think it would be desirable to adjourn it for a week.

The discussion was then adjourned till February 29th.

February 29th, 1874.

COLONEL F. C. STEPHENSON, C.B., in the Chair

ADJOURNED DISCUSSION ON DR. LEITH ADAMS'S PAPER.

The CHAIRMAN: Before renewing the discussion which was discontinued this day week, I beg again to remind you of the necessity of limiting the two points of discussion as much as possible to the two questions mentioned, viz., "whether a perfectly efficient system of Short Service and Reserve can be secured by Voluntary Enlistment?" and "supposing Short Service and a Reserve impracticable, what schemes of Continuous Service and Pension are likely to be successful?" These two points really are the pith of the whole subject of Dr. Adams's paper, and it is exceedingly desirable that any gentlemen who wish to speak should confine themselves as much as possible to those points. One other point I should like to call the attention of the meeting to, which is the desirability of avoiding, as much as possible, any argument or expression which can in any manner be interpreted as having a political bearing. I think that is of very great importance, and also I hope remarks may be devoid of any warmth of expression which might give offence outside these walls.

Col. EWART, C.B., R.E.: I attended here last week, and listened very attentively to all that was said. It appeared to me that there were three points to which Dr. Adams directed our attention. The first was the supposed insufficiency of the supply of recruits; the second was the supposed indifferent nature of that supply; and the third was the difficulty of finding a Reserve. These all bear upon the two

questions which have been submitted to us for discussion. A number of incidental matters also bearing upon these questions were brought out by various speakers. It appears to me that, inasmuch as the Journal of this Institution is published and very largely circulated, and is not only circulated amongst our own Officers in our own colonies and at our own stations, but also goes into the hands of foreign Officers, and finds its way into foreign libraries, and the matter in it is introduced into discussions abroad, it is very desirable that any deficiencies in our service should not be unduly exaggerated, and that the real state of things should be brought out in these discussions. Therefore, from that point of view I would speak first as regards the supposed insufficiency of recruits. I happen to have had the opportunity of referring to some statistics upon this matter, and I have taken the opportunity of consulting the latest returns showing the numbers of recruits that have been raised, and I should wish to bring before the meeting, in opening the discussion this evening, the real state of things at the present moment, namely, that the Army is considerably over its strength. It is quite true last summer there was a great deficiency of recruits, and that the winter season is the time for getting recruits, but from whatever reasons, the fact of the matter is, that at the present moment the Army is over its strength. Some regiments—and no doubt this has given rise to the supposition that there is a great want of recruits—some regiments do want recruits; on the other hand, others are in excess of their numbers. The artillery at the present moment may want 700 or 800 men, but why? Because they have sent out large drafts to India, and have not had time to recruit up. The Highlander regiments, too, are in want of men, but that, no doubt, will be remedied in time. We must recollect that in this matter of recruiting, there have been great changes of late years; that we passed from the system of long service and pensions, to the system of general service and short service: that that again has been altered into county service, and that now men are taken for the county regiment, and when these regiments are full, recruiting is opened at the brigade depôts for other regiments belonging to other depôts which want men. Only about 28 depôts out of the 70 proposed, have as yet been brought into working order, but I believe, from all the inquiries I have made, that at those depôts which have been brought into working order, the recruiting has been most successful with very few exceptions—there are a few exceptions, especially in Scotland. The measures which were proposed within the last two years for accelerating recruiting, and for leading up to a Reserve, have hardly had time to come into force; in fact it will be some years before any men pass under these measures into the Reserve. Therefore it may be rather premature to judge of how far these measures are fitted to give the Army a Reserve. As regards the indifferent nature of the recruits now furnished, we had the opportunity of hearing from the Inspecting Field Officer of the London District last week that he was perfectly satisfied with the men who are raised for the cavalry regiments in London. The Lecturer's remarks with regard to the indifferent nature of the recruits as I apprehend, mainly referred to the infantry recruits raised under his immediate superintendence in London. The question in my mind is whether those remarks will refer to the men who have been raised at the country brigade depôts. From all I have heard, I have reason to believe that they do not apply to the same extent. I am rather more disposed to believe that the same sort of men who used to enlist for the infantry in the country, do still exist—that there is very little difference in the men. Of those who enlist in London, no doubt the superior men go for the artillery and cavalry and the Guards, and a certain number of men who come to London thinking they will get work, and be well paid, fail in these objects, and then enlist for the infantry. I am disposed to think if the statistics could be obtained as to the relative nature and stature of the men now enlisting in the country, and the men who used to enlist, it would be found that they are very much what they were before. Supposing that you get the same men, I hold—and I think the Lecturer stated so in his remarks—that the advantages that have been given to them in their barracks are very far superior to what they used to have, and I would add to what he said in his paper, the great advantage of the present gymnastic training, which has been shown by the Army Medical Reports to improve the men very much in the chest measurement, and in their general strength and power. Therefore I am disposed to think that these measures which have been introduced, such as giving them greater cubic space in

barracks, giving them gymnastic training, giving them recreation rooms and amusements in barracks—these sort of things have all tended to the improvement of the soldier. Whether or not the present measures contemplated for passing men through the ranks, and then getting them into the Reserve will answer, it will take time to show; but this must be recollected, that what you really want in the present day, when we look at what foreign nations are doing, and at the state of their organisation, is a Reserve, and you want a particular kind of Reserve. You want a Reserve that is immediately available to complete your regiments for service. Two sorts of Reserves are proposed in this country—the one Reserve is of men who have passed through the ranks, and the other is of the Militia. I think, with all due deference to the Militia, that every one must allow that the most fitting men to join the ranks and embark at once for service in the field, are rather those men who have passed through the ranks of the regular Army than the men who have only been out a month in the year, for training with the Militia. But when war once begins, then comes the great advantage of a Militia Reserve, because when the regiments of the line embark for foreign service, the Militia take their place, and by degrees, being embodied and being in barracks, become able to fill the regiments that are on service with thoroughly efficient men to join the ranks. I will not prolong what I have to say, although I might touch upon many matters dwelt upon last week, inasmuch as I think it is desirable that I should not exceed the limits which the Chairman has assigned for speakers in this discussion.

Captain ROGERS, Staff Officer of Pensioners, Longford: No one as yet has touched upon the Irish side of the recruiting question, and it is to this that I shall particularly direct my observations. My sub-division lies in the centre of Ireland, and for the last two years I have witnessed a continuous efflux of the able-bodied population to America, and I am of opinion that the allurements held forth by their relatives in America are so practical and irresistible, that it will go far to drain the population of the district where I have been recruiting. I rather think that in this great competitive age, the Irish recruit is unfairly handicapped. As a smart, intelligent soldier, he is second to none, but he is, as a rule, totally ignorant of the "three R's," and, therefore, cannot look forward to quick promotion. But the Irishman is a soldier from the shell. His very instinct teaches him to learn how to fight best, and from my own observation, I can say it is perfectly marvellous to notice how quickly a batch of Militia recruits will pick up their drill. It is while this process of training is going on that such lads begin to ask about the Army and its advantages, and that is the time in my opinion to secure their services and draft them into the Army. I therefore think that Commanding Officers of Militia regiments should be compelled in some way to encourage the transfer of their men to the line. But there is another drawback even when no objections are raised on this score. The recruiting sergeant and the Militia Staff contend about the bringing money, and so nothing comes of the privilege accorded by the Commanding Officer and his Adjutant. To my mind this bringing money has as demoralising an effect as the obsolete bounty. It is a mere premium on crimping, and it is responsible for the many perjuries spoken of by Dr. Adams when he told you that the majority of the recruits are nominally 18, but virtually they are only 17 years of age. As example is better than precept, I can instance a case myself. A Militia corporal brought a man of his company before me for enlistment. The recruit made the usual declaration, and I enlisted him, but before testing him, I made enquiries and found out that he was a married man. Of course I had to proceed against this poor dupe as a rogue and a vagabond, although he told me that it was the corporal who induced him to say that he was unmarried, and he was prepared to swear to it. Reward your recruiting parties you must, and considering the paramount importance of their duties, I think you cannot reward them too much, but this bringing money ought, in my opinion, to be accorded to the recruit and paid to him when he has learned his drill. As to the short-service system, there is no doubt that the most reckless wretch in the world will at some time or other during his six years' active service bethink himself of the future. He may bear no good character in the regiment; he may have such a number of regimental entries against him that he has given up all hope of being re-engaged. What does he say? "I won't waste my time here. I will desert, and seek some

"permanent employment." On the other hand, the appropriation warrant recently promulgated as regards the fines for drunkenness, will undoubtedly offer incalculable incentives to the well-conducted soldier. I am myself convinced by personal enquiry that there are no more powerful incentives to enlistment than pensions on discharge. My district in Ireland is a proclaimed one, and therefore you may imagine it is not considered very peaceably disposed, but I vouch for it there is one reliable and loyal element there of which little account is taken by the unthinking many, namely, the Army Pensioners, than whom a more excellent, trustworthy and respectable body of men does not exist. When I first went to Longford, I was paying my men alphabetically at an out-station when a very old man entered. "Sir," he said, "I used always to be paid first by your predecessor, for I am a "Waterloo hero." I said, "Well you shall be paid first, because you were all "heroes at Waterloo." And, Sir, one out of ten or twelve recruits whom, after the utmost exertions, I have only been able to pass into the Army within two years, came from the village of this Waterloo hero—a pensioner at 9*d.* a-day. Dr. Adams, I think, was rather hard upon little men. He seems to have forgotten the famous dictum of General Picton, which however I will not repeat here. Dr. Adams thinks an average height of 5 ft. 7 inches is procurable, or at least is desirable. No doubt it is, but I rather think if you would double the pay of the Army, these men in sufficient numbers could not be obtained. Why not enlist promising boys of 17 years old, say 5 feet 4 inches in height, and send them to large camps of instruction on the chance that the majority of them will develope into stalwart men. As an instance, a young fellow came to me to enlist. He wanted a fraction of the proper height. I said "No, I cannot enlist you, but go into the Militia for a month or six weeks of drill." He did, and then he came back of the right height, and I enlisted him. There is one other point I wish to allude to as indirectly bearing on this question. A great deal has been done towards the social amelioration of the soldier, and I have no doubt it will be appreciated, but how about the married soldier? Let the single man see that his more respectable comrade has his interests looked after, and good results will follow. In connection with the Victoria Hospital at Netley, a number of cottages have been built for the accommodation of soldiers' wives whose husbands have been invalided from Colonial stations. This admirable institution is the result of a local charity that needs and deserves the support of the Army. Elevate and respect the condition of the well-conducted soldiers, and depend upon it the country will never want for recruits nor a reliable Reserve.

Lieutenant-Colonel AIKMAN, **M.C.**, Commanding R.E. Middlesex Militia: It is with great diffidence that I venture to make a few remarks, after the observations of the many distinguished Officers who have spoken on this important subject; but from the information gathered from Dr. Leith Adam's paper, and the opinions already expressed, it would appear that, unless some means be found to make the Army Bill more effective in its results than it has hitherto been, we shall shortly neither have an efficient Army nor a reliable Reserve Force.

Our first object should be to discover the reason for the widespread dissatisfaction among our soldiers, and want of confidence pervading the minds of those people belonging to the class from which our recruits are chiefly drawn. I cannot help thinking that Sir Percy Douglas has ascribed the general distrust to the right cause viz., the abolition of pensions. When we consider how much the prospective advantage of pensions is coveted by all classes of the community, securing a zealous and honest performance of duty at a comparatively small cost, and that this mode of rewarding long and faithful service has been in operation for generations, it is not surprising that the abolition of this institution should have served as a severe blow to the interests of our poor soldiers, who, coming from a class of unsettled habits, have nothing to look forward to in the future, and therefore accept the low rate of military pay, in the hope of ultimately securing a pension, to preserve them from ending their days in the workhouse. It seems to be the general impression that pensions are not consistent with short Army service, followed by long service in the Reserve. To my mind the pension system is peculiarly essential to a mixed service of this kind, because, when you discharge a soldier from the Line into the Reserve, after a short service, he is obliged to take up some other means of subsistence, and in the absence of some prospective benefit accruing from his former military service,

he will not be forthcoming when wanted. Mr. Hay Hill, a gentleman of considerable experience in the labour-market, states, that the spirit of the age is opposed to pensions. Now, Sir, I deny that the people of this country are less disposed than formerly to reward long and faithful service, or that the Government *employés* and soldiers are less inclined to accept a moderate rate of pay, followed by this kind of reward. Mr. Hill's observations, I think, apply to the skilled operations connected with the Labour League, who wage perpetual war against capital—men who strike when their master is fixed with a contract, who change their situations periodically, and have no feeling in common with their employer. There is nothing in this relation to call for a pension, and I need not say that it would be an unfortunate day for us when these conditions existed in the Army, even though it were possible to pay our soldiers according to the labour-market rate; but, returning to the operative, whether he is engaged with this master, or that, he is employed in productive industry, and the country sustains no loss. Not so with the soldier. His training is costly, and if discharged after a short period, he becomes a civilian in every sense of the word, and the money expended upon him is lost.

I cannot help thinking that, had the Army Bill in its original intention proved successful in drafting soldiers of three years' training into the civil population, without any link with the Army or Reserve, an element of discontent would have been raised up in this country that sooner or later would have proved a serious inconvenience, and of no military utility whatever. Now, we have four distinct bodies in our Army and Militia, the Line, the Army Reserve, the Militia Reserve, and the Militia. We recruit for the Line through the Militia: this I believe to be wrong. The Militia should be composed of people of a different class, with settled homes and employments. It is from the Line and Militia recruiting in the same field, that a sufficient number of men of proper *physique* are not procurable, and that so many desertions and frauds are practised with impunity.

When men of unsettled habits make up their mind to join the Army, they first enlist in the Militia; they receive their bounty, clothes, &c., and then desert. They sell the Government property, amounting in value to £5, for what it will fetch, and then enlist in the Line. Having succeeded so well in the first instance, they continue their migratory habits in the regular service so graphically described by Colonel Lyons, the recruiting Officer. I had 48 men walk off in one morning; a few were caught and sentenced to a fine of £2 10*s.*, or three months' imprisonment by the civil power. By this arrangement the delinquents had a balance in their favour by the transaction. I need not say that this mode of treating desertion and theft is admirably calculated to ruin the *morale* of any military body. I have made a rough sketch of a plan based on the pension system, which appears simple, inexpensive, and capable of modification, to meet the requirements of the Army and Reserve. I estimate the cost of a soldier at £50 per annum. I take 35 years, that is, from the age of 19 to 56, and divide this term into four periods of service: 1st period, seven years in the Line, at £50 = £350; 2nd period, seven trainings in the Militia Reserve, at £7 per training = £49. The soldier having performed 14 years' service, would now be entitled to 6*d.* per day kit and rations, while training, amounting to £13 per annum, = £91. Having concluded his third term, or 21 years' service, during which time he is available for active service in any part of the world, he would be transferred to the pension establishment on 1*s.* per day, and be available for home defence. The sum total for 35 years' service amounts to £745, or £21 6*s.* per annum. Now let us compare this with long service: 21 years at £50 = £1,050; 14 years at 1*s.* per day, £252, total £1,302, or nearly double the amount of the short service soldier. The Army Bill, though good in many of its features, has not yet been worked out successfully. Professional jealousy has in no small measure contributed to this result. Line Officers object to give their Reserve men to the Militia, where their services would be invaluable, and Militia Officers are loath to give their best men to the Line. The Militia, under better treatment, could easily extend its recruiting, so as not to interfere with the Line, and by this means the *physique* of both services would be considerably improved, and the men of both forces would be forthcoming when wanted. It is by treating the Reserves in a fair and liberal spirit, that the Line will become attractive, and by suitable measures the vacancies in both would soon be filled; but professional jealousy must be laid aside, and the

Officers of both services must go hand and glove together, to encourage an interchangeable system, for, as Sir Percy Douglas remarked, "it is to the constitutional "force and the Reserves, properly welded together, that we must look for the "strongest fighting power that this country can produce."

Major-General SCHOMBERG, Deputy Adjutant General Royal Marines : I have a very few remarks to make on this subject. It is certainly a very important one; I had the opportunity during the last year and a-half of comparing the working of very nearly the old system with the new. In the Marine corps we recruit for twelve and twenty-one years' service, and we have not had the slightest difficulty in getting recruits. The type of men we get is certainly good—they are very fair men. The standard of the Marine Artillery is a little lower than it was, but we have to recruit a much larger number of men than we had formerly. The establishment was 300 Officers and men, it is now nearly 3,000, and the corps is nearly completed. There is one difficulty that we find, I suppose in common with our neighbours, namely, that there are a set of men who go from one regiment to another, who never stay in any corps long enough to look like soldiers, and who enlist merely to desert. We have no power of marking these men; the country is at their mercy, and the recruiting Officer, however careful he may be, cannot detect that they have ever been in a regiment. I think myself the cure for that would be that we should follow the example of the Roman Army, in which every soldier was marked, as described by the Lecturer. I think if every one of us on joining, were marked with the broad arrow or the Crown, it would be a perfect cure of the difficulty. I should be quite willing to submit to the operation.

It seems to me that there are too many Reserves. I think there should be only one, barring the Volunteers, whom I wish to see encouraged, and not discouraged. I think that the two lines, the fighting one and the Reserve, should be formed of the Line and the Militia. I do not see why there should be any medium between the two. It seems to me if localisation were carried out carefully, and in its first intention, the Line regiment should be recruited from the Militia, and should send back its old soldiers to the Militia. I think that they should recruit each other. Of course there is no time to enter into detail on the subject, but such a plan seems much simpler than having a Militia Reserve and Army Reserve, and Militia besides.

I should like to say one word as to our being a military country. I think the Lecturer said that we are not a military country. If any country in the world may claim to be a military country, it is, in my opinion, England. We have, I think, won more battles and lost fewer by land than any country in the world; and when history comes to be written, I think the conquest of India, and its reconquest, and our government there, are feats not only of military but of administrative skill, which will certainly mark us as a military country.

Colonel ALCOCK, R.E. Middlesex Militia: The discussion on the last occasion turned very materially upon the labour-market, and the discussion this evening has turned very much upon the manner of procuring an efficient Reserve. I take the liberty of saying a few words, because it appears to me to be impossible by money only, to procure a sufficient force for our Army purposes under ordinary circumstances; and under extraordinary ones, such as war, you have not a sufficient Reserve. Having served in the Militia myself, I wish to give my opinion as founded upon my experience. The Militia originally was formed upon a feudal system. It was officered by the county gentlemen, and they held their appointments by property qualification, the consequences of which were, that men would follow their Officers whom they knew perfectly, who would not move a step to go with a stranger, or to go among strangers. The system of county brigade depôts has rather modified and improved the condition with respect to going among strangers, because county men are kept a good deal together. But you have entirely done away with the feudal system; you are resting entirely upon money, and are thinking nothing of social influence and social position. Therefore, looking at the subject from a philosophical point of view, I say, for the sake of argument, you may consider the Militia as absorbed into the Line. Then in the case of war you have no efficient Reserve. The way to meet that is to cause the whole of the schools throughout the kingdom to join military training with education, and to let them all be what was called a local Militia, officered by the sons of the gentry just entering upon life—obligatory service for two, three, or

four days in the year. The consequence of that would be, that you would prepare a better Reserve. Colonel Ewart has already told you that the formation of a Reserve is a matter of considerable time. Well, you would be prepared with a better Reserve by that voluntary system than all the nations of Europe can produce for aggressive purposes by a forced enrolment of the manhood of their nations. I say that what you cannot possibly do with money, you can do by so simple and obvious a system as bringing the social influence of one class to bear upon another. The future action and future progress of every man depend upon the associations of his youth, and education simply means the preparation of a man for the purposes which his immediate future will require in his national life. Therefore I say that we are coming to that point in which everybody must take his part in the defence of his country; and the proper manner to enable them to do so, is by beginning with the boyhood of a nation, and you will have a Reserve which will be quite equal to competing with the manhood of the nations of the Continent, who are raised by a forced conscription, and one which they are generally very little disposed to obey.

Captain HOSEASON, R.N.: I think a very general but erroneous notion prevails that a soldier who is forced by a conscription to join the Army of his country, is a much cheaper soldier to the nation than the man who joins it voluntarily. I do not think this possible, and I have certainly gone into the subject with great care, and have especially estimated the relative cost of the Austrian, Prussian, and English soldier, and found the cost nearly identical.

A great error has been committed by attempting to arrive at the individual charge of each English soldier, by dividing the total annual expenditure for the British Army by the number of regular soldiers *alone*, that are to be found in the annual vote—this false mode of computing, made each soldier cost 100*l*. But the gentleman who first made this statement, totally lost sight of the fact, that within such gross estimate is included the amount paid to the Militia, Volunteers, Yeomanry, Pensioners, and Reserve, with every fresh investment in plant, and also addition made to our valuable accumulation of military stores, not only in England, but in all the various powerful military positions we possess in every quarter of the globe.

Dr. CAMERON, Deputy Inspector-General of Hospitals, h.p.: I am one of the youngest members of this Institution, and I have certainly learnt that most novel and surprising information is to be gained by attending its meetings. I allude particularly to the remarks of Colonel Ewart, who first addressed us this evening. I had imagined, from reading the military papers of the country, and from conversations with Staff Officers and Pensioners, that the general opinion of the officials of the Army was, that there was a deficiency in the matter of recruits. But now I learn that so far from there being any deficiency of recruits, we have an overplus of them. I have also learnt that my eyes have deceived me. Although I have spent my life as a Military Medical Officer, in judging of men, I now learn the fact that my eyes must have deceived me excessively. Having looked at regiments with all the feelings of an old Officer, with regret and grief I now learn, that this has been an ocular deception, and that those regiments are composed of the very same kind of men who used to enlist in the service. Well, that is a very surprising piece of information, and I hope it is correct. As regards the remarks which other Officers have made, they have referred to the subject of bounty, and pensions, and long service. One gentleman favoured us with a calculation of the cost of bringing a man up to 56 years of age in the Army. Well, evidently from the tone which the discussion assumed last evening, and from the general opinion of military society, we all regret the abolition of long service and of pensions. I do not say much about bounty, because I think the system carries with it a condemnation of the trade it is inviting. For when you have to offer a man a bounty to take a certain situation, it is some proof that the situation cannot be a very promising one; but pensions and long service, of course, we all believed in. Well, Sir, these are gone, and we have to deal here with accomplished facts. Therefore, I propose to apply myself to the first question, namely, "Whether it is possible to secure an Efficient System of Short Service and Reserve by Voluntary Enlistment?" Having devoted much consideration to the subject, I think it is possible. But to do so, we must depart altogether from

established traditions, which I need not tell you is a most difficult thing in England. We must quit the old groove, and start on an entirely new one. And to do that, successfully, the gentlemen who rule those matters must be familiar with the public opinion of the barrack-room, with the opinion of the mechanics' workshop, and of the village ale-house, and all places from which we draw our men. I took the liberty of telling Mr. Cardwell, very respectfully, that it was not for me to say who had drawn up his numerous warrants, but that whoever drew them up, though he might be a very clever civilian, he was perfectly ignorant of the public opinion of the barrack-room. They seem very nice warrants to look at, but they will not work. I propose to depart, in great measure, from the system on which the soldier has been rewarded. Accepting as accomplished facts what has been done, I say we must deal with matters as they are. To start; I should keep the period of 12 years' service. I spent the whole of last month in one of our largest garrisons, and I was there told by a medical Officer that he was enlisting men for six years' service with the colours, and six years in the Reserve, and that he was also enlisting men for twelve years' service with the colours in an infantry regiment. My friend, Dr. Adams, an authority on these matters, assures me that there must have been a mistake. That, however, is a matter of little consequence, because we are enlisting men for twelve years for the cavalry and the artillery. However, I propose to take the twelve years' service, but instead of drawing a hard-and-fast line, I shall confine myself to saying that a man after six years' service with the colours, should be eligible for the Reserve, if he chose to go into it, and if it suits the policy of the Government at the time, to permit him to do so. I confess I put that proviso in with some little idea of baiting the hook, so that a man may not be frightened at the idea of tying himself up for twelve years. We will suppose a recruit brought into barracks. I should propose to relieve him from all charges for his food. I know for a fact that this is a matter which accounts for much of the desertion that takes place among young soldiers. The recruit is told by the sergeant if he enlists he will receive bed and board and 1*s.* a-day. No sooner does he get into barracks, than he is called upon to pay 3½*d.* a-day for his groceries or small stores, and he thinks he has been done. He never was aware of that; he gets sulky, and thinks he has been cheated, and very rapidly reconciles his conscience, if he has any of that commodity, to the idea of breaking the bargain by deserting, and he does desert. I should relieve the soldier altogether from the multiplicity of accounts. Threepence-halfpenny is an awkward sum to calculate for buying groceries, and I should relieve the man from that altogether. I should give the soldier three good meals a-day, and if any circumstances, except those of field service, prevented the man from getting those rations, I should compensate him liberally for the loss of them, and should also give compensation, of course, to married men on leave. I should then alter the system of paying the soldier by the day. The men whom we enlist, have never been accustomed to be paid by the day; they have either been paid by piece-work or by weekly wages. Therefore we should pay the soldier by the week. And as we take off the charge of 3½*d.* which amounts to 2*s.* 0½*d.* a week, I should propose to take 1*s.* off his pay, and to say, "Your pay is 6*s.* a week, and your bed and board." That would be an addition to his present pay of 1*s.* 0½*d.* Considering the state of the labour-market, nobody can possibly complain of that addition. Then there is this to be borne in mind, that the soldier must keep up his kit, and keeping up a kit in these days, with camp life and autumn manœuvres, is a very different affair from what it was in the days of country quarters and company detachments. The soldier is now called upon to encounter in peace a great many of the hardships that he used to consider peculiar to the state of war. Graphic descriptions of the men floundering through the mud may be very amusing, and so may pictures of the same in the *Illustrated London News* for ladies to look at in their drawing-rooms; yet it is anything but a laughing matter to the poor fellows who have to do it. Their clothes are destroyed. With regard to these clothes, I wish to make a statement, which is, that the clothing now issued from the central establishment at Pimlico, is not nearly equal to that issued under the old system of what we called the Tailor Colonels. The Tailor Colonels were one of those peculiar anomalies of which there are plenty in the British Constitution, but, for all that, it worked admirably; for anybody who is acquainted with old soldiers who have lived long enough to try both systems, will know that two of the old brick-dust looking

coats were, for wear and warmth, equal to three of the coats issued now. I allude to that on account of the additional expense which has been entailed upon the soldier. Soldiers were my earliest playmates, and I have spent my life among them, and, as any medical soldier who does his duty, ought to be the soldier's friend and confidant, I flatter myself I have always been so, and I claim to know as much about soldiers as any man living. Now, I was talking to an old respectable soldier of nineteen years' service during last month, and he told me that, in former days, such a thing as a soldier's buying salts of lemon and cleaning drugs was almost unknown; but that now they are constantly obliged to spend small sums upon these matters in order to keep their things decent. The soldier only gets one pair of cloth trousers annually, and one pair of summer trousers biennially; and to keep these, and to keep his boots in order, will cost a very economical man as much as 4*d.* a-day. It would require him to be a very careful soldier to do it on that. No Government, I think, could object to increasing the soldier's pay by 12½*d.* a-week. I should then give him no additional pay; I should do away with so-called good-conduct pay altogether, and I could give many reasons for it. I should give him no increase of pay until he has served six years; then I should give him another shilling a-week, and there should leave him. At the same time, I take this opportunity of saying I think Non-commissioned Officers are very much underpaid. This is a matter of the highest importance. Everybody knows it is exceedingly difficult very often to get men to take to the stripes. I should propose to add to each corporal's pay 1*s.* 6*d.* a-week; to sergeants, 2*s.* 6*d.*; colour-sergeants, 3*s.*; staff-sergeants, 3*s.* 6*d.*; and to sergeant-majors, who are some of the worst-paid men in the service, 5*s.* Now, to provide for the man on his discharge. The system I propose is this. I should establish in every regiment in the service a yearly discharge fund. That is, on the 1st January, 1874, I should have opened in the regimental savings-bank ledger an account headed "Discharge Fund of 1874." To this fund I should credit 2*d.* a-day for every man who joined in 1874, and to that fund also I should credit all the fines levied upon the members of the fund, and I should substitute fines, as much as possible, for other punishments. Instead of sending men to prison and leaving others to do their duty, I should fine them to the utmost possible extent, and add the fines to the fund of the year in which the man had joined. On the 31st December in each year, I should balance that fund and add to it the regulation interest, and yearly, in January, I should publish a statement of the fund in the regimental orders. Thus, in the first week of January, 1875, I should publish an account of the discharge fund of 1874. Assuming that there stood to its credit on the 31st December the sum of £100, and there were forty men to partake in it, the share of each man would be £2 10*s.*, and I should publish the names and numbers of the men referred to. In each man's pocket-ledger, I should then credit the sum of £2 10*s.* as his share of the fund. Of course the first year would necessarily be a broken one, because men would enlist at different periods, and their daily twopences must all be put together and equally divided at the end, and in this way the youngest recruit at the close of the very first year of his service would find to his surprise—probably he had never owned 5*s.*, or at least certainly not a whole sovereign in his life before—that he had money in the bank which had got there without any exertion on his part; in fact, that he was already a man, in a small way, of property. Each succeeding year, every man in the regiment, from right to left, would find himself richer by £3 0*s.* 10*d.*, in addition to his share of the fines levied upon the members of the fund, and also his share in the casualties arising from deaths and desertions or retirements. These funds should then go on, year by year, until the close of the eleventh year, because as soon as the twelfth year comes, men would be discharged from time to time. Therefore on the 31st of December, at the close of the eleventh year, I should close the fund finally, and allot the money to those men of 1874 who were still on the rolls of the regiment, be they many or few. If there was only a single man remaining, the whole accumulated fund should be his. The fund should be finally closed, and the money should be considered the man's property, and handed over to his heirs in case he died between that period and the time when he could claim his discharge. As each man's day of discharge comes, hand his share of the fund to him. If he was a notorious character, such as could not possibly be trusted with the disposal of a large sum of money, then Government should have the

power to purchase an annuity for him. It requires some calculation to realize what sums men might possibly obtain. Multiply £3 0*s.* 10*d.* by eleven years, and you have a sum of between £30 and £40, and adding to that the compound interest, you will perceive the recruiting sergeant can tell the man with perfect truth that at the end of the comparatively short period of twelve years, when he would be a young man, and not more than 32 at the outside, he would be safe to have forty guineas in his pocket. Forty guineas, I hope, to most of the gentlemen I have the honour of addressing is comparatively a very moderate sum indeed, but to a man in the situation of most of our recruits it is an almost fabulous sum. Such men have never possessed in all probability £5 together in their lives, and the sum of forty guineas handed to a man would enable him either to emigrate successfully, or to set up in a small business, or to do fifty things. It would send him home to his friends at any rate favourably impressed towards the service from which he derived his benefits. But very much larger sums than that might be obtained. I went to the actuary of the insurance society in which I am insured, and got him to turn up some tables and calculate the percentage of deaths, and considering the changes and chances of an English soldier, serving, as he does, all over the world, military mortality far exceeds that of civil life at the same age. Supposing a regiment enlists one hundred men in one year. I see that last week's military papers mention a regiment coming home now which will require 200 recruits, and I knew one myself a few years ago that enlisted 300 men in one year. Supposing a regiment enlists 100 men this year; you have then a discharge fund of 1874 which starts with an income of over £300 a-year to be accumulated at compound interest for eleven years. That is capable of amounting to a very large sum. What would prevent any single man out of that company becoming the sole possessor of that treasure? Such a thing is quite on the cards. Suppose the regiment meets with another "Birkenhead" or Balaclava, it will go very far to realize it. Mortality prevailed to a very great extent in the colony where I served. A company was sent to a very nice-looking station—certainly it was a good many years ago, and at the end of the month there was one Commissioned Officer and three privates left out of them. So late as 1824, 113 Europeans died of fever out of 420 men in two garrisons in Ceylon. That is an extraordinary mortality, but such casualties as the "Birkenhead" and Balaclava, and many others may be met with any day. For instance, we might read and pass over without surprise, an announcement in the newspapers that at Peshawur there had been a violent outbreak of cholera, and 40 men had been carried off. That, of course, would tend to benefit the survivors. Now, however, our soldiers are called upon to enlist and to give us the flower of their life without deriving the slightest benefit. Our men have gone out to the Gold Coast. What advantage would it be to any man to come home the last survivor of his corps? There was a man in my own regiment who came home covered with medals and clasps, having gone through all the battles in Upper India and so forth—one of eight survivors of those who embarked with the colours twenty years previously. What was his fate? He was discharged on a pension of 8*d.* a-day. What impression of the service did that man give? He must have become a burden upon the rates, and would only serve as a beacon in his native village to warn young men who might possibly think of going to be soldiers. We experience great difficulty in obtaining recruits for the Royal Artillery. Now in a corps like the Royal Artillery the discharge fund of each year would amount to a very large sum, and as each man thinks every one mortal but himself, the men, instead of having nothing, as they have now, to look forward to but a distant prospect of getting an additional penny a-day if they can contrive to pursue a path of undeviating military rectitude for two years, each man would cherish the hope of being one of the few fortunate survivors of his year. At present men will tell you that they do not like the service, because there is no chance for a man in it. I have taken as a sort of jury upon this plan the Corps of Commissionaires in London, who must be the best judges on these subjects. I have submitted the details to them, and they have met with their approval. With regard to this particular point of pensions, a friend who took great interest in the matter told me he had been speaking to an Officer of considerable service, a cavalry Major, who told him he himself had no faith in anything but the restoration of the shilling a-day pension. I submitted that to my friends, the Commissionaires, and what was their

answer? "Oh, that gentleman knew nothing about it. What is a shilling a-day "when you get it? You have to wait 21 years for it. At the end of that time "you cannot work. What can you do on a shilling a-day. No, it is infinitely "better to give the man the chance of getting a good sum of money when he is a "young man, and the man would infinitely prefer it." On the system I have advanced for your consideration, no soldier could possibly leave the Army without being to a certain extent provided for. No man could go away and say he had not had a chance in life. That system would also put a stop to the very painful sight of men who have been hurt early in the service and discharged, because I should provide that a soldier disabled in action should carry away with him from his regiment the sum that was last credited to him on the previous 31st December. It would be impossible to extend that provision to men disabled by sickness, because that would open the door to all sorts of imposture. There can be no mistake about a man who gets a limb badly broken in action. About three years ago, at Brecon, riding in the very heart of the recruiting ground of the Welsh Fusiliers, who were then in that district, I stumbled upon a fine young man with the 23rd coat upon him sitting by the roadside ready to receive anything I might give him. I pulled up sharp, and asked what brought him there? He said, "I am a poor fellow who has got a "bad leg from a wound, and I cannot do anything." I said, "You look very well; "what is the matter with your leg?" "Oh," he said, "I have had a piece of bone "come right out," and he pulled up his trousers, and I saw it was so. He said, "I cannot do anything." I said to him, "What did you get?" "Sixpence a-day "for two years, and my leg does not get any better, and I can do nothing." I said, "What are you doing here?" "Well," he said, "the old regiment is coming up "here; I was waiting to see if I could get something from them." I pitied the man very much, and gave him half-a-crown and rode on. In the same way I have met soldiers repeatedly. I met a man in 1873 who had served eight years, and got his eye destroyed with ophthalmia at the Cape, and was discharged with sixpence a-day. This system that I have sketched out would put a step to all that, No man could complain that he was left penniless, or had not had his chance, and many men might get considerable sums of money. At the end of the 11th year, when the fund was closed, if the men continued to serve we should give them the twopence a-day till their time expired, which would make the pay 8*s*. 2*d*. a-week. If men who had completed 12 years' service chose to re-enlist for nine years more, I should certainly take them, if they were medically fit and of good character, but not otherwise. They would then be entitled to a pension, for under the present system a pension is not absolutely abrogated. A man may get permission to re-enlist and serve 21 years, and then get a pension. In that event I would give a private a shilling a-day pension, and the other ranks a fixed sum in like proportion. I think we should endeavour to get a better stratum of society for our soldiers. We have heard of the comforts of the barrack, but the real state of things is very different. We are enlisting the very scum of society. A private artilleryman at Woolwich has recently depicted the state of society in his barrack-room, and pointed out that no respectable family would think of allowing their son to join in an atmosphere of such pollution and vice. I have heard the same thing repeated, and have been told by men that others join the regiment with whom they cannot sit at the fireside, their obscenity and filth are so outrageous. I say we should endeavour to get a different class of men into our Army, and to do that, the Government should pledge itself to give the soldier who has served with a good character, a preferential claim for all manner of civil employments. If the regulations said that a soldier when he was discharged with a good character should have a preferential claim for all minor civil employments, such as in the police, railway staff, Government porters and messengers, it would act much more powerfully in bringing respectable men into our ranks than a pension would, because it would ensure them respectable civil employment for all their days. You may have noticed in the papers that a short time ago 22 postmen were wanted at salaries of 18*s*. or £1 a-week, and they were to be examined. Well, the Commissioners were rather surprised to find a thousand well-dressed, respectable-looking young men attending and requesting to be examined. That may give one an idea that if respectable civil employment were to be secured to men who had rendered a certain service to their

country it would be a great advantage. We have abundant means for it. There is no country in the world that has such a number of these rewards at its disposal as England. Still further, I should abrogate the present unsatisfactory system of bestowing commissions from the ranks, and should set aside a certain number of first commissions every year to be competed for by soldiers who had served three years with unblemished character, and men of strictly temperate habits. I should have these commissions competed for by papers, on the system adopted by the Staff College, of course with a degree of qualification suited to the class of people who are to compete for them, and who should be afforded every facility for qualifying themselves at our schools. Of course you would not expect these men to know conic sections, and all those things with which young men are now addling their imperfectly developed and unformed brains in these competitive examinations. I have known repeated instances in which people's heads have been quite destroyed, young lads who have been muddling their souls out over these things; of course you could not expect that. You would expect military qualification, and you would get a class of men into the service who would be fitted for it.

Col. LYONS: With the permission of the Chairman, there is a matter I wish to explain as there appears to be some misunderstanding. It is as to the term of enlistment of recruits. I have been Inspecting Field Officer in London for the last three years, and am fully conversant with all the orders and regulations and so forth with respect to the recruiting. The periods are these: for the cavalry of the line, recruits are enlisted for 12 years; for the Royal Artillery, 12 years; for the Royal Engineers, 12 years; nothing to do with the Reserve up to the present. For the infantry of the line recruits are enlisted for six years with the regiment and six years in the Army Reserve, with the exception of boys, who are in all cases enlisted for 12 years. A warrant came out about April or May last to the effect that men would be authorised to be enlisted for 12 years in such numbers as from time to time should be directed by the Adjutant-General. From that time to the present no order has been received by me in London to enlist men for infantry at the 12 years.

General Sir WM. CODRINGTON: There certainly is nothing so important to the Army as the first enlistment of the recruit, to obtain him with his *physique* not requiring hospital treatment, to be able to do duty as soon as he has done his drill. Every Officer who has been in the Army knows that this is most important. Those who were in India during the mutiny, or in the Crimea, found that when young recruits came out, you might reckon on one-third or one-half, not doing their duty during that Indian mutiny, or not going down to the trenches when they came before Sebastopol; many of them as soon as they were brought up went into hospital. Just trace the effect, which the Lecturer will know perfectly well—they go out from home, they have to be put into hospital, and other people have the care of them, either in hospital on shore, or in the hospital ship. They are then sent away, have to go back to England perhaps 2,000 miles, at an enormous expense to the country, taking the place of the really good men that you ought to have enlisted at first. It must therefore be perfectly clear, that in the first enlistment the *physique* of the men is one of the most important things we have to deal with. Something was mentioned just now, I think as a quotation, about our not being a military nation. That expression, I believe, comes from the celebrated historian of the Peninsular war, that we were a warlike, but not a military nation, merely meaning that we had all a tendency to fighting and to war, but that we had not the organization which perhaps other nations have; but I do not think it was intended to represent that we were not a good soldier-like nation, when it came to the push. I think the instance Dr. Cameron mentioned about it costing the soldier fourpence a-day to keep up his kit must be a mistake. I think that must be fourpence a-week; but that is a very minor point. The first point put down for discussion is, "Can a perfectly efficient System of Short Service and Reserve be secured by Voluntary Enlistment?" It is a sheer question of money. It is so, not only in the Army but in every class of life; if you ensure a man being paid by an engagement for twenty years with a pension, we know very well that he can do with less money than if you only hire him for a week or a fortnight. The same principle applies to short service. If you pay the soldier up to the price of the labour-market, I will be bound to say you will get

men in England as you got them before. I remember the Secretary for War of the day said, on the question of a conscription—"No, we will not have a conscription, "we would rather pay for the labour we require." Now, if we did pay for the labour we require, we should get the men, but we do not pay at all up to the labour-market; and as long as you do not pay up to the labour-market, what is to induce a man to become a soldier? He does not get his pension, he is put in a barrack-room, he has to give up his liberty; half the Army is in India, which means banishment from his friends; there are many disadvantages to be considered, and the man's father and mother, particularly in the country, think twice before they will allow him to enlist. There is no doubt, if you require men and it is a matter of importance to get them, you must pay for them; if you choose to insist upon short service without pension, you can get men if you pay more for them. The other question is—"Supposing short service and a Reserve impracticable, what "schemes of continuous service and pension are likely to be successful?" What schemes of continuous service and pension are likely to be successful I really do not know, except this, that we have known the time when there was an attachment to the service, when the men entered a regiment and remained in it as their home, until they were discharged and got their pension. That shilling a-day undoubtedly prevented a man starving; he was enabled to live in his parish in the country, and was not pointed out as being in positive distress. Taking that away and giving comparatively no equivalent, you certainly do not attract the men, and I rather apprehend, the class of men that you get, is not equal to those who formerly enlisted for permanent service. I believe that is the tendency of the lecture, that you get an unformed young lad who is of no service to you for some time; whereas in former days you were more able to pick your men. I think, if the Army is to be a profession, with regiments localized, we ought to have no recruiting parties at all; the men ought to come to us, instead of our going to them. There are regiments in the service at this moment, namely, the Household Cavalry, which never have recruiting parties—and why? Because there is such a demand for the situation, why or wherefore I do not know, that they always have men on their lists; and if a man misbehaves, they say, "We do "not want your service any more," and they get another in his place. The Officers in the Army will be exceedingly glad if the Army were so well paid, or its advantages were so great that we could imitate that system, and we could do as other employers of labour do, namely, that the different head-quarters, particularly the depôt centres, should be the local establishments for recruiting, so that you would be able to say, "here is the centre, you must come to us," and when a man comes to you, whom you do not know as of good character, do not take him; that would be the best way to get good men in the Army, and if you pay them well, I believe there are plenty of men in this country who would make you very good soldiers yet.

Major WETHERED, Paymaster R.A.: I think those gentlemen who have taken part in the discussion, as well as the Lecturer, so far concur in saying that the Short Service Act has not been a success, but a disappointment. There is one point, I think, which has not been very much noticed, and that is, with regard to the way in which the recruits are taken. It is admitted that about 60 per cent. of the recruits we raise, are under 18 years of age, possibly a large majority are not more than 17 years of age. We take these men into the regular Army from 17 up to 23, and at the very time they become effective soldiers, we turn them out of the effective Army, and hand them over to the Reserve. It is well known to all military men, that no soldier is so effective as a man who has been about ten or eleven years with the colours, providing he is a trustworthy, steady man; and if we are to take men for merely six years, and then turn them out into the Reserve, I think we are upsetting the whole system. A great deal has been said about the matter being merely a question of £ *s. d.* So it is to a large extent. If we go into the labour-market and make our bid for the material we want, we should get that material, provided we pay the price for it. But when we come into the labour-market, we must remember that the soldier is a distinctly separate class from every other. An employer goes there and finds a labourer fit to perform the work he requires, pays him his price, and that labourer enters into an engagement with him. After he has served his em-

ployer, he is in a better position to go and seek employment elsewhere; but we go into the labour-market and buy the rough material. It really is not of so much consequence what we pay, the great expense is in the education of that material. It takes two or three years to make a man a soldier, he then becomes of great value to us, and it is not so much a consideration what we have to pay him, but how, when we have gone to this great expense, we are to retain him as a contented member of the service. There must be the advantage of progress in his position, and we must hold out some hope of advancement. I think it is very important that the man should have something to look forward to, he should be assured that, when he is worn out in our service, he will have a certainty to fall back upon. The pension, certainly, will cause a man to cling to the service, and it has always been an inducement to good conduct, because a man increased his pension by his continued good conduct. I am sure, if any suggestion thrown out at this lecture can be beaten into shape, we shall confer a great benefit upon the State. So far, I have not heard of any proposal which appears to me to answer all the purposes. I have no doubt a committee, quietly discussing the matter, would be much more likely to arrive at some satisfactory conclusion as to the best scheme to adopt.

I cannot say that I agree with any proposal that I have heard. I do not think it is a wise plan to lay by a certain sum daily, and to accumulate a fund, so that the men will be able to get a certain sum when they leave. We should have to look after them, to see that the men were provident with it, because, in nine cases out of ten, the money would be thrown away. Then, again, we want to keep these men in this country. If you take a soldier after fifteen years' service, and give him a lump sum of money, that man would not be fit for employment in this country; he would simply take his money and go off to America, and so we should be losing the very man we want to retain. If the man has a pension, and can look forward to an increase, by good conduct, he remains in the country, and we have him to fall back upon; therefore, I think it is much better that a man should be able to look forward to a pension than to a bonus sum, created by a daily increase of reserved pay. The great thing is to hold out inducements to soldiers, and we should increase the advantages of Non-commissioned Officers. Dr. Cameron proposed that you should hold out certain commissions for those men to compete for. Of course, in that case, we must raise the pay of the Commissioned Officers, for, otherwise, I do not think the advantages appertaining to the commissioned rank would induce a man to enter into the service. If we were to open up more positions to them, it would be an advantage. With regard to the subject of fines, I think they may be carried beyond a prudent limit. I do not think it is wise to create fines in all directions. The men will get dissatisfied, and desert. No doubt desertion at present is very rife, and it is a pity that we have departed from the custom of branding the deserter. A man who deserts, deserves to be branded, and I do not see why we should be so delicate about it. I think we shall not benefit much unless some committee of practical Officers is appointed to consider the whole subject. No doubt, if some scheme can be proposed on the basis of short service, it will be a very great advantage as regards the creation of an efficient reserve.

Dr. ADAMS: In reply, I wish to point out with reference to the supposed defect referred to by Sir Percy Douglas, with regard to the table of the nationality of recruits raised in the United Kingdom, in 1872, and in 1860, that the numbers furnished by Dr. Barclay, Army Medical Department, are produced merely to illustrate the statement in the lecture, "that the supplies of Irish recruits have much deteriorated of late years;" the data, therefore, are altogether disconnected with "rejections." which have no bearing on the point under consideration. The same observation is applicable to my statement, of having examined 25,000 men, and remitted 17,000 into the Army, this being advanced merely to show my experience of the *physique* of the recruits inspected by me during the last two and a-half years. The table showing the minimum heights of the British, German, and French soldiers, was compiled from official data in the War Office, the French being taken from a late report on the Reform of the French Army, translated by Major Home, R.E., and the German data were furnished by Captain Cooke, who, being present, can vouch for their accuracy. It should be understood, however, that although the minimum height in the German Army is as low as 61·8 inches, this does not imply that the figure is to be

considered in any other light than showing the lowest possible standard of height admissible, indeed, unless during great emergencies, the probability is, that not ten men are taken annually of this low standard—the usual minimum height standard in peace time being 63 inches, and that even is believed to be exceptional, and requires an otherwise unusual good *physique*, to which the Germans pay the greatest attention in the selection of soldiers, as they do to all military details. It is therefore absurd to compare minimum standards of height without taking the age into account, seeing that our lowest age is 17 or 18, and that of the conscript 20, the former being a lad, and the latter a matured man. With reference to the figures 6·4 and 6·8, representing the ratio per 1000 of colonists who entered the Army in 1860 and 1872, these embrace colonists who enlist in their own country or in the home Army, or even half-castes; for instance I examined lately a magnificent man, whose grandmother was a Maori. The table showing the comparative heights of recruits raised in 1845 and 1873 is furnished altogether with the view of showing the large number under 5 feet 6 inches in height who enlist now, as compared with thirty years ago. It was taken from returns in my office, and I believe it to be under the mark as regards the entire force. One gentleman inquired whether the falling off in the *physique* of the linesman was not a sign of a deterioration of race. My opinion is that this is not so, and that the loss of the Irish element, and the high rate of wages and demand in the labour-market, have required a corresponding reduction in the standard of height, and other physical requirements, so that recruits have to be taken from a lower physical stratum, which abounds with inefficient men of poor *physique*.

Colonel Ewart has said that the *physique* of the soldier is as good now as it used to be, but in this opinion I cannot agree with him, and the tables just described, together with the general opinion of all competent observers, show that there has been a regular and decided falling off, which had been gradually increasing of late years. The experience of the recruiting district in London is great, as it furnishes about one-third of the entire annual supplies of recruits for the whole Army: indeed, one has only to look at the infantry soldier now and think what he was thirty years since, to feel convinced that there is deterioration in his *physique*, for which a remedy has been indicated. Captain Rogers is mistaken in supposing that I said that no recruit should be taken under 5 feet 7 inches in height, the idea being that only promising men should be accepted who would come up to this standard at the prime of life. I am not averse to accepting recruits of low stature so much as I have the fear of getting many unpromising lads, of a low standard, who will never improve afterwards; to wit, the wretched undergrowth of cities. I agree with Dr. Cameron and others, that not only the pay, but the position of the non-commissioned staff may be improved, with the object of inducing a superior class of tradesman and the like to enlist. I also perfectly agree with all the valuable opinions and suggestions that have fallen from Sir William Codrington: indeed I feel that I have become a much wiser man by this able discussion, which, although it may not indicate any particular scheme for recruiting and the formation of a Reserve, there can be little doubt that it has fully established the necessity for remedial measures.

The CHAIRMAN: Before we part I have a very few remarks to make. The first is to the effect that there seems very little doubt that we are all of opinion that it is a simple matter of pounds, shillings, and pence, as to the solution of this great difficulty in getting efficient recruits. I think we are also very nearly, if not entirely, unanimous upon this, that the best way of employing the money of the country is by applying it to pensions. The discussion has been very ample, and the subject pretty well exhausted, and I only hope that it may be turned to good account. It only remains for me to propose a vote of thanks to Dr. Adams for the very able lecture that he has given us upon a subject of such deep interest to the Army generally.

LECTURE.

Friday, March 13, 1874.

GENERAL J. R. CRAUFURD in the Chair.

THE RETREAT OF THE TEN THOUSAND; A MILITARY STUDY FOR ALL TIME.

By Major-General J. L. VAUGHAN, C.B.

IT has often occurred to me, that in our admiration for the wonderful achievements of war which we have witnessed within the last few years, we are apt to undervalue the exploits of earlier ages, and to forget how much the modern art of war owes to its earlier professors. I would put it to our military professors and students to say if they still give that attention to the campaigns of Alexander, of Hannibal, and of Cæsar, which Napoleon declared them to deserve; and if the modern idea is not that for instruction in the art of war, it is useless to go farther back than the present, or at least than the last century. Yet bold as the assertion may seem, I believe that there are some branches of the art of war which have almost stood still for the last 2,000 years. For instance, does modern history, I would ask, record any military retreat conducted with more ability or more success, through every variety of country and climate, than that famous one of 400 years B.C., which is the subject of my lecture this afternoon? Or, again, in what campaign of modern times have the difficulties incidental to military operations in mountainous countries been more skilfully and successfully surmounted, than I hope to show you they were by Xenophon and his famous Ten Thousand Greeks, when they fought their way, for eight successive days, through the rugged mountains of Kurdistan? It is to the interesting narrative of Xenophon, as bearing chiefly upon these two branches of war, that I now invite your attention.

What this famous body of Greeks, known familiarly as the "Ten Thousand," achieved, may be briefly summarised thus:—

After a march of 1,600 miles from the western coast of Asia Minor to the Plains of Babylon, they defeated the portion of the Persian Army opposed to them in the battle of Cunaxa. The unfortunate death of Cyrus in that battle, and the consequent defeat of the Asiatic portion of the Army, having brought the expedition to an untimely close, they then fought their way homewards, for 1,800 miles, opposed first by hordes of Asiatic cavalry and light troops, and afterwards by a suc-

cession of warlike tribes, who were aided in parts by a most difficult and mountainous country, and by a climate of unusual severity. Nevertheless this body of Greeks eventually reached the shores of the Black Sea, with diminished numbers, it is true, but in unbroken order, and with their discipline and military efficiency unimpaired.

Let me in a few words first recall to your remembrance the circumstances out of which this famous retreat arose, with such further notice of the composition of the Ten Thousand, and of their numbers, drill, and discipline, as may serve to elucidate Xenophon's narrative, and clothe the subject with greater reality, and therefore interest for modern students.

In the year 401 B.C., Cyrus, commonly known as The Younger, being then 24 years old, and the Viceroy over a large portion of Asia Minor for his brother Artaxerxes, King of Persia, formed the design of dethroning his brother, and seizing the Persian crown for himself. During his tenure of the Viceroyalty, he had been brought much into connection with Greeks, and had become deeply impressed with their superior military and political ability, as compared with the native Asiatics. He was therefore naturally led to desire the services of a body of Greek auxiliaries in such an enterprise as he meditated. The times were favourable. The long war, known as the Peloponnesian war, after lasting 27 years, had lately ended. Many Greek citizens, who had served in the war, and become accustomed to a military life, were out of employ. Political causes had sent others into exile. Thus there was no want of eligible recruits, ready enough to enrol themselves under the banner of a young, popular, and openhanded Prince, whose service promised good pay, adventure, and distinction. Indeed, so attractive were the offers of Cyrus, that many young Greeks of good family are said to have run away from their homes to enlist; and sober citizens, hoping to return, after a brief service, with fame and wealth, readily embarked their money in the purchase of arms and outfit, and even advanced funds for the same purpose to their less opulent friends. The inclination to enlist was sharpened by the belief, promoted by Cyrus, that only a short expedition against one of the neighbouring independent provinces was in contemplation.

It is interesting to notice the material of which the Greek force under Cyrus thus came to be composed, because it probably had an important bearing upon its subsequent history. Just as the superiority of modern German Armies is generally attributed to the superior social position of the men whom war places in the ranks, so I think it a fair supposition, that the superior class of men, of whom the ranks of the Ten Thousand were at least partly composed, was a main cause of the success with which they extricated themselves from a situation of unparalleled trial and difficulty.

Recruits being thus plentiful, Cyrus was enabled to commence his expedition with a body of Greeks, amounting to not less than 14,000 of all ranks; but by the time that the real object of the expedition was fully developed, and the combined Greek and Asiatic forces came to be actually arrayed against the Army of Artaxerxes, in the plains of Babylon, the Greek contingent had fallen to 12,800 men. Of this number,

10,400 were of the class called *Hoplites*, or heavy-armed, and 2,400 of the class called *Peltasts*, or light-armed, the latter number including 200 Cretan archers. Of Greek cavalry there were only about 40, and all of these deserted after the battle of Cunaxa. The *Hoplites* of that period wore, as defensive armour, cuirasses and greaves, carried large shields, and were armed with long spears and swords. The *Peltasts* wore defensive armour of a lighter material than the bronze or iron, of which the armour of the *Hoplites* was made. Their shields were small and round, instead of oblong, and their spears were short and handy. They were a description of troops of very recent creation at the time of Cyrus's expedition; but their value, as we shall see, was fully proved in the course of the retreat. All the Greek troops alike were provided with brazen helmets, and their tunics were scarlet or purple.

This large body of Greeks seem to have owned no generalissimo, except Cyrus himself. Each Greek general commanded the men he had himself enlisted as a separate division. Of these generals, Xenophon mentions the names of eight, the most prominent of whom were, in the first instance, Clearchus, Proxenus, and Menon. The characters of all three are drawn by Xenophon with great distinctness, and I shall quote at length his character of Clearchus, because it gives us a curious insight into the state of discipline in the Greek Armies of the period.

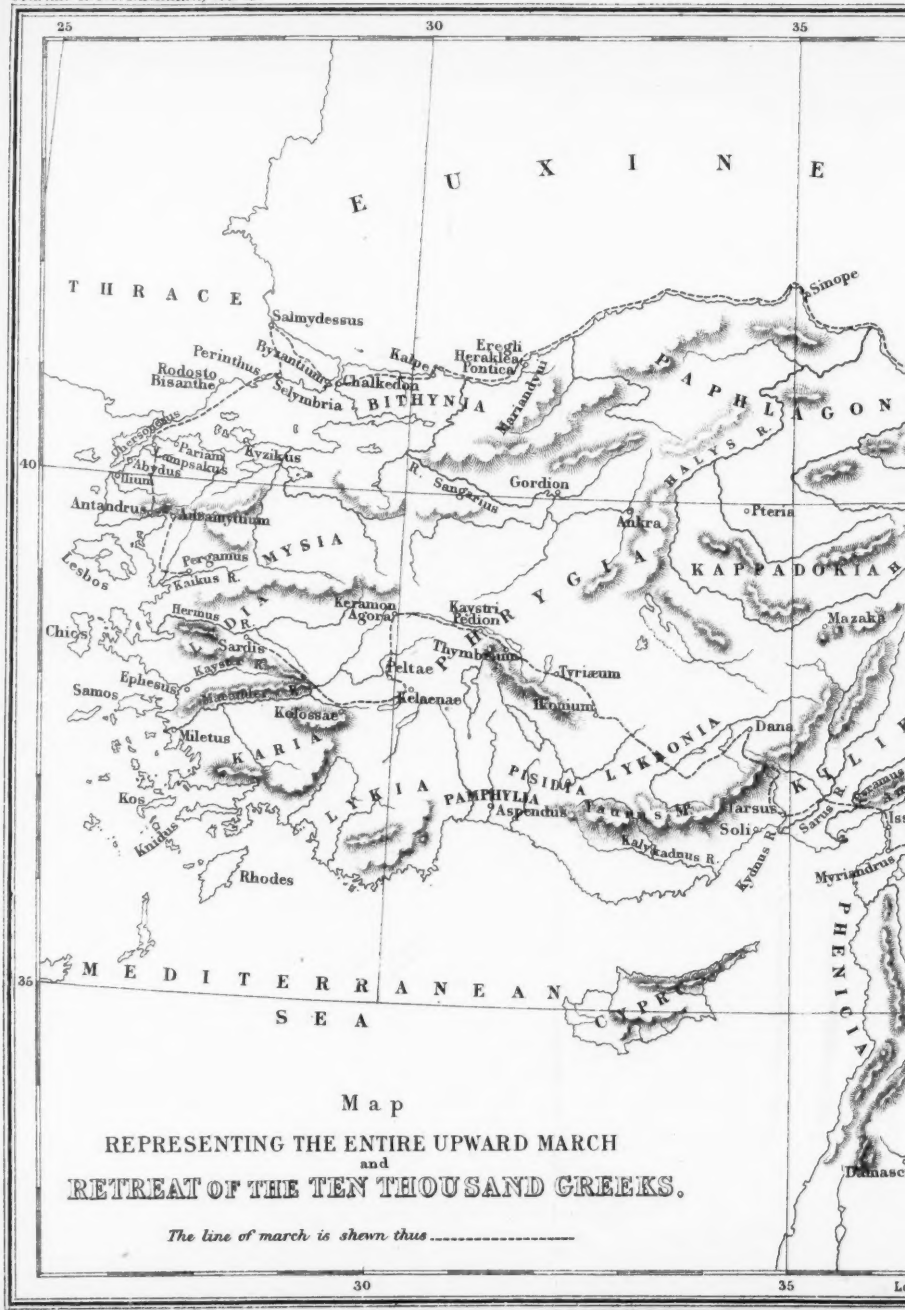
"Clearchus," says Xenophon, "liked perilous adventure, was ready "to march day and night against the enemy, and was possessed of "great presence of mind in circumstances of difficulty, as those who "were with him on all such occasions were universally ready to acknow- "ledge. For commanding troops he was qualified in as great a "degree as was consistent with his temper, for he was excelled by no "one in ability to contrive how an Army might have provisions, and "to procure them; and he was equally fitted to impress on all around "him the necessity of obeying Clearchus! This he effected by severity, "for he was of a stern countenance and harsh voice; and he always "punished violently, and sometimes in anger, so that he occasionally "repented of what he had done. He punished, too, on principle, for he "thought that there could be no efficiency in an Army undisciplined by "chastisement. He was accustomed to say that a soldier ought to fear "his commander more than the enemy, if he would either keep guard "well, or abstain from doing injury to friends, or march without hesi- "tation against foes. In circumstances of danger accordingly the "soldiers were willing to obey him implicitly, and wished for no "other leader, for they said that the sternness of his countenance then "assumed an appearance of cheerfulness, and that what was severe in "it seemed undauntedness against the enemy; so that it appeared "indicative of safety and not of austerity. But when they were out "of danger, and at liberty to betake themselves to other chiefs, they "deserted him in great numbers, for he had nothing attractive in him, "but was always forbidding and repulsive, so that the soldiers felt to "him as boys towards their master. Hence it was that he never had "anyone who followed him out of friendship and attachment to his "person; though such as followed him, from being appointed to the

" service by their country, or from being compelled by want or other " necessity, he found extremely submissive to him. And when they began " under his command to gain victories over the enemy, many circum- " stances concurred to render his troops excellent soldiers, for their " perfect confidence against the enemy had its effect, and their dread " of punishment from him rendered them strictly observant of disci- " pline. Such was his character as a commander, but he was said to " have been by no means willing to be commanded by others."

From this description of Clearchus's treatment of his soldiers, and the habitual severity imputed to him, we may see at once that Greek Armies were at least not what Sir Charles Napier called " Debating " Societies," and that the soldiers on the contrary, were subjected to what even we, with our modern ideas, should consider very harsh discipline. This view is further confirmed by several circumstances in the history of the Ten Thousand which Xenophon incidentally relates. Thus, on one occasion we read of Clearchus inflicting a flogging upon a soldier of Menon's division, whom he judged to be in the wrong in a dispute with one of his own men; and though this nearly led to a very serious affray between the two divisions, yet the grievance was, not the nature of the punishment, but that it had been inflicted on a soldier not under the authority of Clearchus. On another occasion, when a road was being made for the passage of the Army, we find this same Clearchus, whose authority as Commander-in-Chief of the Greek Auxiliaries seems in the progress of the campaign to have become tacitly acknowledged, superintending the labour of the soldiers with his spear in his left hand, and a stick in his right, and freely belabouring those who did not work to his satisfaction. Even Xenophon, who ordinarily trusted almost entirely to his power of oratorical persuasion, did not hesitate, when he rose to command, to strike with his fist, soldiers whom he could not otherwise compel to the requisite exertion, and we know that the Army generally fully justified him for doing so.

And now one word as to the drill and tactical instruction of the Greek troops.

The drill of Cyrus's Greek Auxiliaries appears to have been of a very elastic kind, and to have admitted of a variety of formations according to the circumstances of the moment. For instance, when it was desired to make an imposing display of the troops, as on the occasion of a review before the Cilician Queen, described by Xenophon, the Greeks were drawn up in a four-deep line. At the battle of Cunaxa a similar, or certainly not more solid, formation was adopted; the Greek Commanders having doubtless accurately gauged the character of the troops opposed to them. Later on, when the attacks of a numerous cavalry and light troops in an open country had to be provided against, a hollow square, with advance and rear guard, was the formation adopted; and this again was quickly modified as soon as its inconvenience was experienced. When the progress of the retreat took the Ten Thousand into a mountainous country, they seem chiefly to have fought in small independent parties or companies; and in the last serious engagement before they reached the sea, they adopted with



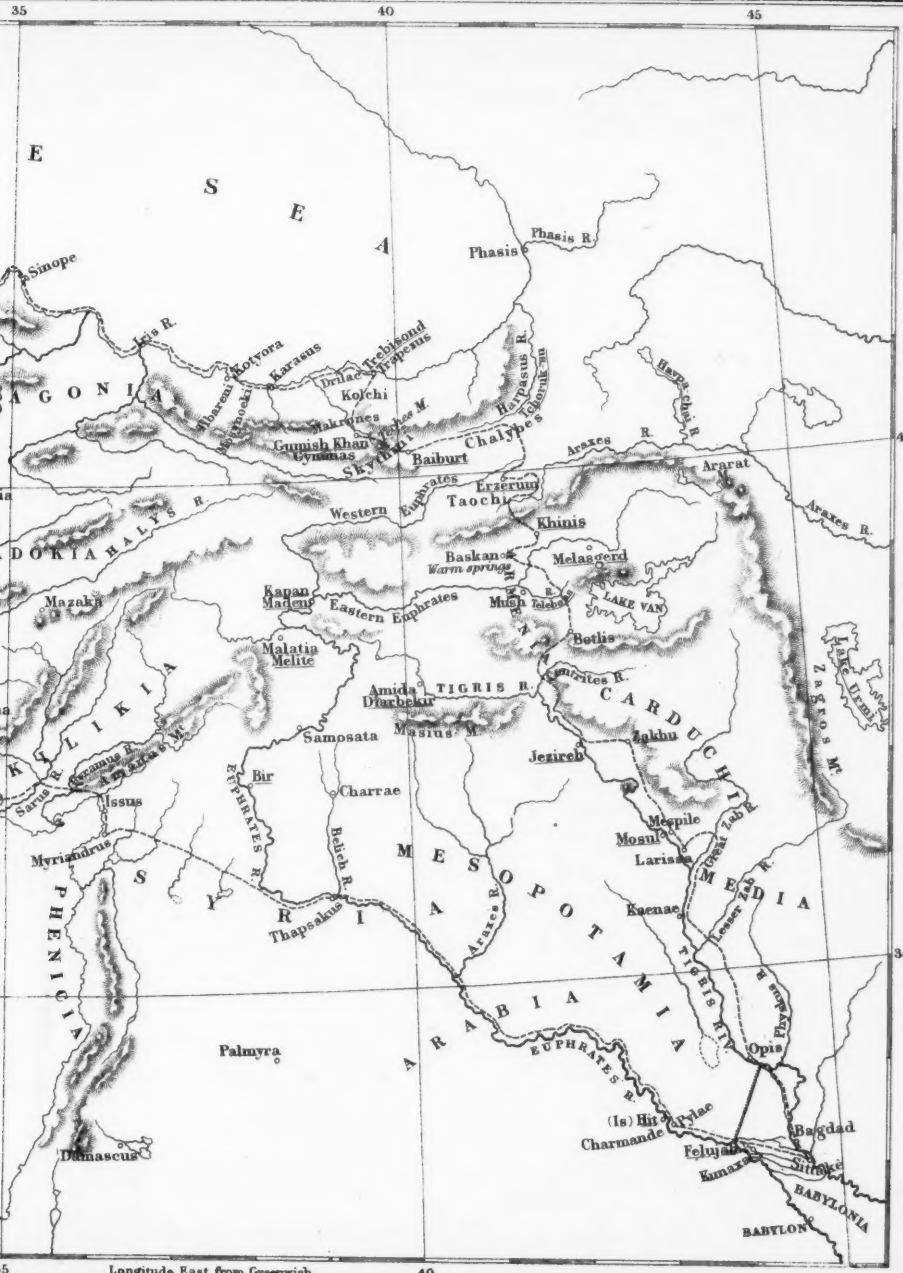
Map

REPRESENTING THE ENTIRE UPWARD MARCH

and

RETREAT OF THE TEN THOUSAND GREEKS.

The line of march is shewn thus ----------


35
40
45
E
S E A
Sinope
Phasis
Phasis R.
Iris R.
Harsena
Kotyora
Karasus
Drilae
Trebisond
Trapezus
Kolchi
Harpasus R.
Colonus M.
Hayra Chan R.
Makrones
Gumish Khan
Lymnias
Skydisi
Chalybes
Baiburt
Araxes R.
Ararat
Western Euphrates
Erzerum
Taochi
Khinis
Araxes R.
Baskan
Warm springs
Melasgerd
Kapan Maden
Eastern Euphrates
Mush
Taleb
LAKE VAN
Mazaka
Botlis
Malatia
Melite
Amida
Diarbekir
TIGRIS R.
Amirites R.
CARDUCHII
Lake Urmi
Zagros M.
Samosata
Masius M.
Jakhu
Jezireh
Bir
Charrae
Issus
Myriandrus
EUPHRATES R.
Belich R.
Mespile
Mosul
Larissa
Lesser Zab R.
MESOPOTAMIA
MEDIA
SYRIA
Kuenae
Thapsakus
Araxes R.
ARABIA
Palmyra
EUPHRATES R.
Opis
Physcus R.
(Is) Hit
Charmande
Feluja
Bagdad
Sittake
Kumaxa
BABYLONIA
BABYLON
Damascus
Longitude East from Greenwich

great success what was clearly a line of company columns, as I shall have occasion to notice in greater detail further on.

The expeditionary force of which the Greek contingent thus formed so important a part, commenced its march from the neighbourhood of the well-known town of Sardis in Asia Minor, in the month of March, 401 B.C. Including the native Asiatic troops, the Army consisted of not less than 110,000 men. From Sardis to the plains of Babylon, no enemy was encountered; but the incidents of this prolonged march, though not coming within the scope of this paper, were of the most interesting character. At length, six months after leaving Sardis, the crisis of the expedition arrived. The Army of the Persian King was discovered on the plain of Cunaxa, 36 miles from Babylon, advancing in battle array. The troops of Cyrus were immediately disposed in an order of battle previously determined on. The Greek Auxiliaries took the right of the line, resting on the River Euphrates, the Asiatic troops forming the centre and left. Cyrus's orders to Clearchus the senior Greek Officer, were to direct his attack against the Persian centre, where he perceived that the King had posted himself; justly concluding, that if the centre were once broken, the day would be won. Clearchus, however, fearing that his flank would be turned if he abandoned the support of the Euphrates, disobeyed these instructions, and led his Greeks straightforward against the Persian left wing. The formidable appearance of the Greeks, and their steady advance in line, chanting the accustomed pæan or war song, was quite sufficient to daunt the Persian troops opposed to them, and cause them to take to flight; but while Clearchus continued his victorious advance, matters fared very differently with the centre and left of the allied line. In the centre Cyrus was at first successful in a charge he made, with 600 chosen followers, upon the far more numerous body of horse, which guarded the person of the Persian King. But this success, by causing his followers to disperse in pursuit, was fatal to the life of Cyrus. Though he found himself almost unattended, he could not restrain himself from making a vehement attack upon his brother, whose person he recognised. In this ill-judged attack he was slain; upon which the whole of the native troops on the left were seized with a panic, and fled from the field in irretrievable disorder. When Clearchus, at the head of his victorious Greeks, at last became aware that he was unsupported, he countermarched the Greek line, and led it back towards the field of battle. He was met by Artaxerxes returning from the plunder of the Allied camp, and dispositions were immediately made on both sides for a renewal of the battle. The Greeks manœuvred so as to get the river in their rear, and then advancing with the same intrepidity which had served them so well before, dispersed the enemy without difficulty, and remained masters of the field of battle.

The night which followed, was passed in much discomfort and perplexity by the Greeks, who were still ignorant of the fate of Cyrus. When apprised next morning of his death, an event so disastrous to their future prospects, it may well be imagined how quickly their feelings of triumph at their own victory, were exchanged for dismay and apprehension. Bitterly, but unavailingly, must they then have

regretted the venture into which they had been seduced by Cyrus. And indeed, when we contemplate the forlorn condition of this Greek division, thus left to their own resources in the neighbourhood of Babylon, we need not be surprised that both Commanders and soldiers were well nigh overwhelmed with despair. The Army had come 93 days' march, exclusive of halts, from the western coast of Asia Minor. This long line of march had been planned with the greatest forethought by Cyrus, but even under such advantages, the Army had all but experienced, on more than one occasion, an utter failure of supplies. Now, the only course that seemed open, to the Greek division at least, was to retrace their steps. But in so doing they would have to shift for themselves, and to march probably without map, certainly without guides, without knowledge of roads or distances, without any one to indicate or furnish supplies, and with the whole force of the Persian Empire arrayed against them. The single consolatory circumstance was the reflection of the ease with which in actual fight they had defeated the enemy. This reflection probably saved them from utter despair, and induced them, in the tedious negotiations which followed, to adopt a tone of confidence and superiority, which in reality they were far from feeling. Time forbids me to enter into any detailed account of the anxious events of the next six weeks. It must suffice to say that under a convention with the Persian King, the Greeks eventually agreed to place themselves under the guidance of the Satrap Tissaphernes, who solemnly engaged to lead them back to the Greek colonies on the west coast of Asia Minor. In pursuance of this arrangement, and amidst constantly increasing suspicions of treachery, which, as the event showed, were only too well founded, the Greeks, 46 days after the battle of Cunaxa, arrived at the River Zabatus, an eastern affluent of the Tigris. Here Tissaphernes consummated his treachery by the seizure and murder, at a conference to which he had invited them, of five of the leading Greek Generals, and about 20 inferior Officers. This event, which deprived them of their leaders, seemed to annihilate the last chance which remained to the Greek troops of a safe return to their country.

It is at this point of the history that Xenophon, who was to play so important a part in the subsequent retreat, first appears upon the scene. He was an Athenian citizen, who had so far accompanied the Army in a private capacity only, that is to say, as a guest of one of the murdered Generals, Proxenus. His connection with the Army had therefore up to this time been of a no more official character than that of the "special correspondent" of our own day, of which enterprising class Xenophon may fairly be considered the prototype. On the mournful night which followed the seizure and murder of the Generals, Xenophon, like the rest of the Greeks, lay down to rest wakeful and dispirited. He tells us, that falling as he did into a brief sleep, he dreamt that he heard thunder, and saw a burning thunderbolt fall on his paternal house, which was forthwith encircled with fire. The dream seemed to his excited imagination to be divinely sent in order to rouse him to exertion, and to stimulate him to break through the stupor which was fatally affecting all ranks.

His first step was to call together some of the Captains who belonged to the division to which he had more immediately attached himself, and to urge upon them the necessity of immediate action. These Officers at once came into Xenophon's views, and encouraged him to address himself to the surviving Officers of the other divisions. These also assenting, the assembled Officers proceeded at once to elect new Generals and Officers in the place of those murdered, and to convene the Army in general assembly, in order to submit and obtain confirmation of the new appointments, as well as to decide on further measures. Xenophon, in this general assembly, was again the principal spokesman; and on his recommendation, the most vigorous resolutions were passed. It was determined that there should be no surrender; that all wheeled carriages and superfluous baggage should be at once destroyed; that the Army thus lightened should then march to the nearest villages where provisions were obtainable; that the march should be in hollow square, with baggage and followers in the centre; that Cheirisophus, one of the surviving Generals, should, in virtue of his being a Lacedæmonian (Sparta was then supreme in Greece), lead the van of the Army; that certain other of the Generals should command on the flanks; and that Xenophon and Timasion, the two Generals youngest in age, should command in rear. This, I may remark, was Xenophon's post throughout this retreat; and we may judge, by the invariable steadiness and enterprise displayed by the rear guard, how soon both Officers and men felt the influence of his resolution and spirit.

We may now therefore consider this famous retreat fairly commenced. The soldiers, after destroying all superfluous baggage, took such refreshment as was procurable, and the line of march was formed. Cheirisophus led the advanced guard, which was composed of 300 picked *Hoplites* or heavy infantry, and a due proportion of *Peltasts*, or light infantry. Then followed the main body in hollow square; and Xenophon brought up the rear, with a rear guard, also composed of *Hoplites* and *Peltasts*, and a detachment of Cretan archers and javelin-men. The rear guard was harassed during the whole of this march by a body of Persian cavalry and light troops. The Greek light troops, overpowered by numbers, were driven in; and this obliged Xenophon to employ his heavy infantry to repel and pursue the enemy, a service for which they were ill adapted, and which they performed with indifferent success. Impressed with the serious danger which thus threatened the Army from the inferiority of their light troops, and entire want of cavalry, the Greek Commanders devoted the night which followed to organising a small body of 50 cavalry, to replace the horsemen who had deserted after the battle, mounting them upon the spare horses belonging to the murdered Generals and other Officers. They also induced some 200 Rhodians, noted as adepts in the use of the sling, to form themselves into a body of volunteer slingers. The rear guard having been thus reinforced, it fared better the next day. As soon as the Persian cavalry and light troops approached to attack, the trumpet sounded, and the Greek cavalry and the slingers issued forth, being duly supported by the infantry of both classes. The charge was so boldly pushed by the

Greek horsemen, that several of the enemy were overtaken and killed, and 18 of their cavalry made prisoners. This bold reprisal deterred the enemy from attempting any annoyance during the two next days' march. But on the third day a much more serious attack was made by the traitor Tissaphernes in person, at the head of largely increassed numbers. The Rhodian slingers, however, used their slings, and the Cretan archers their bows, with such good effect, that the Persians were soon driven to a respectful distance, and contented themselves for the rest of the day with following and observing the line of march. It was at this period of the retreat that the Greek Commanders saw the necessity of modifying the hollow square in which the main body had hitherto marched. To correct the liability of such an unwieldy formation becoming disordered, when passing obstacles on the line of march, they caused a number of detached companies to move upon the flanks, so as to be ready at once to fill up gaps and to rectify any disorder; another instance, you will observe, of Greek fertility of resource, and of the adaptability of their tactical formations to all circumstances.

For the next four days the retreat was continued without material incident; but on the fifth day the character of the country changed. The road now lay through a succession of low hills, above which, on the right flank of the Army, rose a lofty mountain. The order of march which had hitherto served the Greeks so well, now became unsuitable; and as the exigency had not been foreseen, no provision had been made for it, and some disorder ensued. Taking advantage of the ground, and of the close formation of the Greeks, the Persians pressed the few Greek light troops who were available to oppose them so hardly, that they drove them, in great discouragement, within the square. This obliged the heavy infantry to take up the fighting; but though their spirit was excellent, they were necessarily at great disadvantage in following the enemy over such rugged ground. This was the first experience of hill warfare which the Greek commanders had had; but they seem to have grasped the correct principles of such warfare at once. A strong body of *Peltasts*, a description of troops which, as I have already endeavoured to explain, combined some portion of the steadiness and solidity of the *Hoplites*, or heavy infantry, with the agility of light troops, was at once called out from the right flank of the column, and directed to scale the mountain, and establish themselves on the summit, and thereby gain the command of the enemy. As soon as this was accomplished, the enemy gave way, and no longer attempted to oppose the march of the main body. The detachment of *Peltasts* was then ordered to continue its march along the summit of the mountain, abreast of the column; and presently the main body reached some well-stored villages, where the whole force reposed for three days, to make arrangements for the wounded, who were numerous, and to reorganise for future efforts. "Here," says Xenophon, "it was "found necessary to appoint eight surgeons for the Army."

Not discouraged by their failure on the last occasion to stop the march of the Greeks, the enemy, a few days later, availed themselves of a similar advantage of ground to repeat the attempt. But the

Greek Generals were this time fully prepared. A strong body of the *Peltasts*, or light infantry, who had done such good service on the previous occasion, was quickly formed; and, having been strengthened by the addition of the 300 picked *Hoplites* of the advanced guard, was instructed to obtain possession of a lofty mountain summit which commanded the enemy's position. Xenophon himself took the command. As soon as the Persians perceived the design of the Greeks, they also sent off a party to get possession of the summit. Then ensued a scene, the like of which has often been seen in the rough mountain warfare of our Indian north-west frontier. Loud cheers rose from the main body of the Greeks, as they watched the efforts of their comrades to gain the summit of the mountain, and were answered by corresponding shouts of encouragement from the main body of the Persians. Xenophon relates that whilst he was urging on his men, a heavy-armed soldier taunted him with being on horseback, whilst *he* was sweating under his shield on foot! Xenophon replied to the taunt by jumping from his horse, pushing the soldier from the ranks, seizing his shield, and making his way up the rugged mountain on foot as fast as he was able. But this so displeased the other soldiers, that they beat and pelted the man, and obliged him to resume his shield. Xenophon thereupon remounted, and led his men as before, until the difficulty of the ground obliged him again to dismount, and abandon his horse. The race, however, was eventually won by the Greeks, and as soon as the Persian main body found themselves under command from the mountain, they took to flight.

The progress of the retreat now led the Greeks into the difficult and mountainous country inhabited by the Carduchi, the progenitors, I believe, of the modern *Kurds*. Anyone who may have served on the north-west frontier of India—at Peshawur, for instance—will be able to form a good idea from his own experience of what the Carduchi and their country were like. The Carduchi were clearly the prototype of the modern Afreedee, just as their country in its rugged features appears to have afforded a striking resemblance to the mountainous tract which lies between Peshawur and Jelalabad. Just as at this day, too, legends are current on the frontier, of invading armies annihilated in those formidable mountains, so in Xenophon's time was there a legend of an Army of 120,000 Persians having been destroyed to a man, in the Carduchian hills, whilst endeavouring to levy tribute. To this day it is, I am told, the common boast of the modern Kurds, that they have never yet payed tribute to King or Kaiser. That a body of 10,000 Greeks should have been able to force a passage through such a country, was surely an achievement, the merit of which may fairly compare with that of the forcing of the Khyber Pass, in the second Affghan war;—a feat of arms which brought just fame to a distinguished Vice-Patron of this Institution, whom death has lately taken from amongst us.*

I must not pause to relate the admirable arrangements by which the Greek Commanders effected a first entrance into the Carduchian moun-

* Field-Marshal Sir George Pollock, Bart., G.C.B., G.C.S.I., &c.

tains; but I will take the narrative of two subsequent days' march to illustrate my assertion that there are some branches of the art of war —notably that of mountain warfare—which seem to have been as well understood 2,000 years ago as they are at present. On the third day's march through this difficult country of the Carduchians, Xenophon, as usual in command of the rear guard, had been severely pressed by the enemy throughout the march. His repeated messages to the advanced guard to halt, had received no attention. When at last the encamping ground was reached, Xenophon reproached Cheirisophus for this neglect; but that general excused himself by pointing to a crowd of the enemy occupying the crest of a pass a little further on, over which the road lay. It happened by good fortune that the rear-guard had that day made two prisoners, by means of a judicious ambuscade. Questioned if there was no other road than that thus pre-occupied by the enemy, one of these prisoners refused all information. The stern measure was immediately adopted of putting him to death, in presence of his comrade. His fellow-prisoner then admitted that he knew of another road, so easy as to be passable even for the baggage animals, but that it was commanded at one point by a hill, which it would be indispensable to secure. Thereupon the Greek Commanders demanded to know what Officers would volunteer for this service; upon which four Captains stepped forward, Aristonymus, Agasias, Callimachus, and Aristeas, all four being Officers whose names recur again and again in the narrative as distinguishing themselves in similar emergencies. The Generals then proceeded to allot 2,000 soldiers to serve under the above captains, and I may remark that these 2,000 men do not appear to have been, like the Officers, *volunteers*, but to have been told off by ordinary roster for the duty:—a circumstance which cannot fail to give us a favourable impression of the discipline and good spirit which prevailed in the force, and of the ready obedience yielded by the men to their Officers, even when the service for which they were required was one of peculiar hardship and danger. The "Ten Thousand" seem to have had a provident habit of always taking a meal before setting out upon an enterprise, and the rule was not neglected on this occasion. Xenophon relates that the party, *having dined*, set off by a circuitous route, whilst he himself led out the rear guard to the front of camp, for the purpose of distracting the enemy's attention by a feigned attack. The employment of the *rear guard* on this duty is worthy of note, because it indicates the good spirit of the men composing it, and their attachment to Xenophon, that they should have been ready to follow him on a service from which, as the rear guard of the Army, they might easily have claimed exemption. Their good spirit is still further shown by the fact, which Xenophon is careful to record, namely, that when he led them back to camp at nightfall, the men had not yet broken their fast during the whole day.

In the darkness of the night the party, under the volunteer Officers, missed seizing the height which the guide had indicated, but they surprised a picquet of the enemy, whose watchfires the Greeks found very acceptable during the night, and took up a position, from which they were able the next morning effectually to surprise and rout the Car-

duchian Army, which occupied the pass. A bugle signal immediately informed the main body of the Greeks that the road was free, and they marched up the pass unopposed, though much delayed by the extremely difficult nature of the ground. Xenophon, as previously arranged, conducted the rear guard and baggage by the route taken by the detachment the evening before; and his record of this day's work reads like a page from the despatches of some of our Indian frontier campaigns. He divided his men into two parties, with the baggage between them. The Carduchians, as soon as they saw these dispositions, took post upon three heights in succession, each of which commanded the road. The first height was immediately stormed, with great resolution, by the Greeks, and a party left to hold it, until the baggage and rear guard should have passed. The second height was carried in the same determined way; and the enemy then abandoned the third without resistance. But observing the weakness of the Greek detachment left to occupy the first height, the Carduchians returned, and attacked it with such vigour, that they quickly retook it, killing all the Greeks, who did not save themselves by hurriedly leaping down the rocks. After this success, the Carduchians immediately occupied a height contiguous to the third hill, which Xenophon in person was holding with only a few men, having sent forward the bulk of his party with orders to halt, and pile arms upon a level plateau a little further on. When the time came for Xenophon to withdraw his men from the height, in order to join his advanced party, he experienced exactly the difficulty which to this day constantly occurs in hill warfare under similar circumstances. Emboldened by seeing the Greeks begin to retire, the mountaineers pressed forward, and commenced rolling down big stones upon them from the hill top. So bold did they become, that Xenophon himself, being deserted by his shield bearer, was for a time in great danger, and was only saved by the devotion of one of his men. However, this hard day's work at last came to an end, and we learn with satisfaction that when, as night fell, the rear guard rejoined the main body, they found it established in a comfortable village, and in the midst of abundance of provisions.

The rest of the march through this difficult country was attended with similar incidents, and Xenophon sums up his narrative of it thus:—

"Whenever the enemy impeded the front, Xenophon, ascending the "hills from the rear, endeavoured to get above and dislodge them; and "when they attacked the rear, Cheirisophus, from the front, did the "same. Thus the front and rear of the Army mutually relieved and "supported each other. Sometimes, too, when the Greeks had "ascended a hill, the Carduchians gave them great annoyance when "the time came to retire from it; and as they were extremely active, "and encumbered with no other weapons than bows and slings, they "could always escape, even though they had but a short start. As "archers they were most expert; their arrows penetrated through "shields and corslets, and were of such a length, that our soldiers "would pick them up, and use them as javelins." "Our own Cretan

" bowmen," concludes Xenophon, "rendered great service in this war-
" fare, under their commander, Stratocles."

Enough has been said, I think, to prove that the Ten Thousand had fully mastered the tactical principles of mountain warfare, and that they proceeded exactly as modern troops would do under the same circumstances. I will now pass to a different operation of war, and relate by what able manœuvres the Ten Thousand on one occasion passed a rapid river, in the face of an enemy, threatening them both in front and rear.

When the Ten Thousand, after eight days' continuous fighting, emerged from the Carduchian mountains, they found their further progress barred by the Centrites, a rapid, breast-deep stream, 200 feet broad, and with a bottom of slippery boulders. On the opposite side a body of horse was seen drawn up upon the water's edge, and supported by a force of infantry on the high bank above. What rendered the situation still more embarrassing was, that the Carduchian mountaineers, of whose prowess the Greeks had lately had such ample experience, were collected in great numbers on the slopes of the mountains in rear, prepared to descend and attack as soon as the passage of the river should commence.

After several trials the river was found too deep and too rapid to be forded, and the Greek soldiers halted on the bank, anxious and desponding. Accident, however, revealed an easier ford, about half a mile off, up-stream, which promised the further advantage that the nature of the ground on the opposite bank was unsuitable for the action of the enemy's horse. To this ford the Army was immediately conducted in two divisions, and orders were given that the first division, led by Cheirisophus, should first effect a crossing, the companies marching independently, in file, or, possibly, column of sections. As soon as the first division was well advanced in the stream, Xenophon countermarched the second division, and led it back as if to pass at the point originally attempted. When this movement of Xenophon's was perceived, the enemy's horse, fearing to be intercepted between the two divisions, took to flight, and were promptly pursued by the small band of Greek cavalry, and by the light troops of the first division. Cheirisophus, as soon as he had got his whole division across, marched straight against the enemy's infantry, on the high bank; and Xenophon, observing the successful progress of the first division, abandoned his feint, and marched back to the crossing place. In the meantime the Carduchians descended from their mountains, and Xenophon, to oppose them, had to form a portion of his division into line, whilst the baggage and the remainder of the division crossed the river as fast as possible. To assist Xenophon, Cheirisophus now sent back the light troops which had crossed with the first division, desiring them to advance some way into the stream, as if intending to recross. Xenophon's orders to his men were that, as soon as the Carduchians should arrive within effective slinging and shooting distance, the Greek line should advance at the charging step to meet them, raising the accustomed martial shout. Inadequately armed for close combat on the plain, the Carduchians did not await the Greek onset, and their flight was hastened by the Greek trumpets loudly sounding the signal to charge,

a sound doubtless well known to the mountaineers, from their recent experience. But at this signal the Greeks, previously instructed, instead of continuing, suspended their charge, and turning to the right-about, crossed the river with all speed, under cover of the light troops of the first division, a few of whom, having in their eagerness re-crossed too far, were wounded in this duty. By these able manœuvres the Greeks effected the passage of the river with trifling loss, in the face of an enemy both in front and rear.

The last tactical lesson in the art of war which I shall permit myself to draw from Xenophon's narrative of the retreat of the Ten Thousand will be the forcing of the mountain ridge described as forming the boundary of the Colchian country. It gives me particular pleasure to draw your attention to this incident of the retreat, because it appears to me that the tactical formation adopted by the Greek Commanders on this occasion bears considerable affinity to the company-column mode of attack which has been so successfully adopted by the German Armies in recent campaigns. The Colchian mountaineers appear to have occupied in great strength the summit of a lofty mountain-ridge, which it was indispensable for the Greeks to cross. It was at first intended that the ascent should be made in line; but Xenophon objected to this formation for the following reasons:—"A line," said he, "will probably fall into speedy disorder, if only from the rugged "nature of the ground; and besides this disadvantage, unless the line "is formed of considerable depth it will be liable to be broken—per-"haps in several places at once—by any resolute onset of the enemy; "and if to meet this possibility greater depth be given to the line, our "front will be so narrowed that our flanks will be overlapped by the "enemy. I therefore propose that we advance in a line of company "columns at such distance from each other as to present a front equal "to the enemy's. In this formation, each company, whilst preserving "the general direction, will be able to choose its own path up the "mountain; and if any one company should be hard pressed, it will "receive ready support from those on its right and left; and if even "a single company is able to reach the top, we may be sure the enemy "will no longer be able to hold their ground."

Xenophon's plan was adopted, and the Greek *Hoplites*, or heavy infantry, were accordingly formed for the ascent of the mountain in 80 company columns of about 80 men each. The *Peltasts*, or light infantry, were formed in three separate bodies of about 600 men each, and distributed, one in the centre, and one on each of the flanks of the general line. In this elastic, and yet truly formidable formation, the ascent commenced, the light infantry on each flank, led respectively by Xenophon and Cheirisophus in person, pushing forward somewhat in advance of the main body. The Colchians, to meet the danger which thus threatened their flanks, reinforced them by drawing men from their centre: observing which, the Commander of the centre body of light troops (whose name Xenophon has not omitted to record) with great readiness gave the order to his men to "double," and established himself, with slight resistance, on the summit of the mountain, quickly followed by a support of Hoplite or heavy com-

panies. This success of the centre led, as Xenophon had anticipated, to the speedy flight of the Colchians, and the abandonment of the whole position.

This is the last tactical lesson of the retreat to which time permits me to draw your attention. But the real lesson which this famous retreat teaches the soldiers of all time, lies far deeper, I need hardly say, than mere tactics. The real lesson which I conceive we have to learn from it is, that under the most adverse circumstances—and truly I do not think any body of men ever found themselves under *more* adverse circumstances—if soldiers will only be true to themselves, if they will only determine that come what will, there shall be no surrender, they may confidently hope to emerge victorious from any and every trial. More than this, surely the retreat of the Ten Thousand shows how invaluable may be the efforts of a single man in an Army, even though not at first clothed with authority and in possession of high military rank, if he only determinedly sets himself to rouse and stimulate the flagging spirits of those around him, whether Officers or soldiers. And, further, let us recognise and profit by this example of the value of a leaven at least of men of education and decent social position in the ranks of an Army. Thus, if there had been no Xenophon to point out to the Greeks after the loss of their principal Commanders, and many of their most influential Officers, that their circumstances, though dismal enough, were yet by no means desperate, and that by a resolute effort they might yet hope to open a road to their own country, the Army would, it can hardly be doubted, have thrown up the game by an ignominious surrender, and the history of the retreat would never have been written. Again, if resolution had not been seconded by that readiness of resource and spirit of intelligent action which belongs to education and superior social position, is it not probable that the Greeks would have succumbed to the numerous adverse circumstances which arose one after another in the course of this prolonged retreat?—a retreat which, lastly, it must not be forgotten, carried the Army through a region, the winter of which was hardly less severe than that which proved so fatal to the veteran soldiers of Napoleon, and in which the sufferings of the Greeks from the cold are described in language which reads like a page from Alison or Thiers.

You will, I think, desire that I should, by way of conclusion, briefly recall to your recollection what befell this famous body of men in the later stages of their history None of us, I suppose, can have forgotten the memorable and affecting scene when the Army first caught sight of the Euxine, and the enthusiastic shouts of Thalatta! Thalatta! the Sea! the Sea! with which the soldiers hailed the emblem of their deliverance. The point at which the Ten Thousand, a few days later, struck the shores of the Black Sea, was the modern Trebizond, then a Greek maritime colony under the name of Trapezus. The inhabitants of Trebizond received their countrymen in the most hospitable manner, and afforded them every assistance in their power; but they were still obliged to trust to their own exertions for supplies of food, which they obtained by frequent expeditions directed against the indigenous tribes of the neighbourhood. From Trebizond, after a month's repose,

such as it was, the Greeks continued their march, along the shores of the Black Sea to Kotyora, also a Greek colony. From the field of battle at Cunaxa, to Kotyora, the distance marched by the Greeks is computed at something over 1,800 miles. The battle was fought in the beginning of September, and the Greeks arrived at Kotyora in the middle of May following;—the retreat having thus lasted over more than eight months.

At Kotyora the Army embarked in transports, which had been collected for the purpose from the various Greek maritime colonies on the coast, and was conveyed as far as Kalpe by sea, landing on the way at Sinope (which bore the same name then as now), and being hospitably entertained by the inhabitants, their countrymen. From Kalpe, after many adventures, the Army forced its way by land through the rude tribes of Thracian Bithynia, and at last reached Chrysopolis, a town which was to the Byzantium of those days what Scutari now is to Constantinople. At Chrysopolis the Greeks halted for a week to dispose of the slaves and plunder which they had acquired on the march through Bithynia. But the presence of so formidable a Greek force at that point was so menacing to the safety of the adjoining Persian province, that the Governor, Pharnabazus, set on foot an intrigue with Anaxibius, the representative of the Lacedæmonian power (then paramount throughout Greece) at Byzantium, with a view to his decoying the Greeks, under a promise of pay and employment, out of Asia into Europe. The army accordingly crossed the Bosphorus to Byzantium. After enduring subsequently the shabbiest and harshest treatment from Anaxibius, the Greeks—now reduced to about 6,000 men, but still commanded by Xenophon—were driven by their necessities to accept the offers of the barbarian King of the adjoining country of Thrace, who, after employing them for two months in a winter campaign, ended by defrauding them of the pay he had promised them. Finally, this gallant and ill-used body of men accepted service under the Lacedæmonian banner in Asia Minor, against their old enemy Tissaphernes; and after campaigns of several years' duration, through most of which they still had the advantage of Xenophon's leadership, they ended their service, as a united body, under the generalship-in-chief of Agesilaus, King of Sparta, at the hard fought battle of Koroneia, B.C. 394, in which the Theban troops first showed their ability to hold their own against the veteran soldiers of Sparta.

Evening Meeting.

Monday, 16th February, 1874.

SIR T. GALBRAITH LOGAN, M.D., K.C.B., Director-General, Army Medical Department, in the Chair.

NAMES of MEMBERS who joined the Institution between the 2nd and 16th of February, 1874.

LIFE.

Wilkie, Hales, Lieut.-Col. 29th Regt.
Spring, F. W. M., Capt. R.A.

ANNUAL.

Savory, H. B., Capt. h.-p., 78th Highrs., Adjt. Rl. Lon. Mil.
Elliston, E. C., Lieut. B. S. Corps.
Wright, H. O. P., Lieut. R.M.L.I.
Hay, R. D. D., Capt., Adjt. 3rd Essex Art. Volunteers.
Lumsden, Sir Henry, C.B., K.C.S.I., General.
Welby, A. C. E., Lieut. 90th Regt.
Hughes, J. W., Major 54th Regt.
Gamble, David, Lieut.-Col. 47th Lancashire Rifle Volunteers.
Girardot, G. C., Capt. 106th Regt.
Lyons, W., Col., Assist. Adjt.-Genl. Recruiting Staff, Home District.
Trousdell, W. B. P., Lieut. 7th Hussars.
Spencer-Stanhope, F. W., Lt. 13th Regt.
Crawford, G. A., Major 4th Royal Lancashire Militia.
Gye, Lionel, Lieut. late R.A.

SANITARY PRECAUTIONS TO BE OBSERVED IN THE MOVING AND CAMPING OF TROOPS IN TROPICAL REGIONS.

By Surgeon-Gen. W. C. MACLEAN, M.D., C.B., Professor of Military Medicine, Army Medical School, Netley.

MR. CHAIRMAN AND GENTLEMEN,—I appear before you this evening in obedience to a call from the Council of the Royal United Service Institution, to address you on the "Sanitary Precautions to be "observed in the moving and camping of troops in tropical "regions." In the month of March, 1862, my colleague, Professor Parkes, addressed you "On the causes of Sickness in the English "Wars, and on the means of Prevention." In the concluding sentences of his discourse on that occasion, Dr. Parkes congratulated you "that at last an enlightened policy has been initiated," and that "in the "words of Robert Jackson, the prince of Army Surgeons, the health "of the soldier had become 'a primary consideration of the State.'" And he added, "that it must be for the Army at large, and for the "general public, to support exertions which, without their aid, would "languish and disappear. It must be for us, in fact, not to forget the "teachings of the past, but to make them ever living, that their "warnings shall not be forgotten, and that their lessons shall not be "unfruitful."

It is, I know, a matter of sincere happiness to Dr. Parkes, and to those who labour with him in this cause, to find that the "teachings "of the past," as unfolded by him in the lecture under notice, have not been "unfruitful," and that their warnings have not been "forgotten."

This country has been called on, sorely against its will, to send a small portion of its land and sea forces to chastise an enemy in a climate "where fleets are silently dispeopled and armies melted away," but, unlike too many expeditions that in bygone years have left our shores for a like purpose, the force sent to operate on the Gold Coast has been provided not only with the appliances of modern war, but with everything that science could suggest and the national resources supply, to maintain health and efficiency under the guidance of an Officer, who, to military qualities of a high order, adds knowledge of, and respect for, the art which aims at the preservation of life, and the mitigation of human suffering.

It will be more convenient, and save much repetition, if, at the outset, I dispose of certain matters of importance regarding dress, water, and alcoholic stimulants.

Dress.

An immense stride in advance has been made in the mode of dressing the British soldier; as I had on a former occasion an opportunity of showing in this hall, up to the time of the mutiny of the Bengal Sepoys, one dress was supposed to serve his purpose for duty in India and Canada. This is no longer the case; Officers and men are not now exposed to the rays of a tropical sun, dressed in a manner calculated immeasurably to add to the sufferings and dangers of such exposure; and all who are impressed with the exceeding importance of the subject had the satisfaction of seeing, for the first time in our history, a body of men embark for African service, as comfortably equipped for the climate and work before them, as sportsmen starting for the moors on the 12th of August.

I have to congratulate the Army on another improvement hardly second in importance to the one just mentioned, viz., a vastly improved system of accoutring the soldier. I had, on the same occasion, an opportunity of bringing before the members of this Institution the mischief wrought by the old regulation system, which, while it set at nought all considerations based on the anatomy and physiology of the human frame, was, as a necessary result, most objectionable from a military and financial point of view, from the costly inefficiency clearly traceable to its use. The "Pack-Committee," of which my colleague Dr. Parkes was an active member, after years of patient experiment, at last introduced a system which has solved in a very satisfactory manner both the military and physiological problems submitted to them. We have only to ask any old soldier who has felt the pinch of the old, and the ease of the new equipment, for his opinion on the change, to be satisfied, that little as those whose withers have never been wrung by the old regulation pack and belts may think of it, it is in the estimation of those who have studied the subject, the greatest boon that has been conferred on the soldier since defensive armour

was laid aside. The trials made of the new valise equipment in Prussia have elicited strong recommendations for its introduction into a service where efficiency is so much appreciated; and Professor Morache, of the School of Military Medicine, Val-de-Grâce, declares that the trials made in France are conclusive in its favour, and were so regarded, not only by the soldiers who carried it on marches extending to 32 kilometres = to 20 English miles, without any fatigue, but also by the Officers who superintended the experiments. It is true that the knapsack is not carried by the British soldier in India, but in the old system it was not the knapsack alone that was in fault; every part of the equipment was so contrived as to press with severity on the chest-walls, and to impede the functions of the vital organs within them. The improvements I have thus indicated release me from the necessity of saying more on the importance of allowing free movement to the organs of respiration and circulation, when men have to exert themselves in the heated atmosphere of the tropics.

Water.

It is hardly necessary to say that few hygienic points are of more importance than a supply of the best procurable drinking water for men on the line of march. If this is left to the discretion of the water-carriers in India, they will take it from the nearest available source. After all that has been said and written on this subject of late years, it must suffice to say, that impure water is capable of conveying into the system the poison of malaria, or the germs of dysentery or cholera. The testing and purification of water are now carefully taught to Army Medical Officers, who, under present regulations, are charged with the responsibility of seeing that this is done by all the means available; and in their efforts to effect this, they should be seconded and supported by those in military command.* Filters, such as those contrived by Captain Crease, should be mounted on wheels, and the water-carriers, who attend to the wants of the men, should be obliged to draw their supplies entirely from them. Company Officers cannot be too watchful on this point, and should be diligent in instructing their men in the danger of drinking impure water by the way. Nor should a large supply for douching purposes be neglected. This is necessary at all times in hot weather, whether the men march by night or day. It is on this that Medical Officers place their chief dependence in the treatment of most forms of sunstroke by day, or syncope from great heat radiated from the soil at night. Every soldier marching in the tropics should have some form of pocket filter in his haversack.

Spirits.

If there be any point of military hygiene that may now be regarded as settled beyond doubt or cavil, it is this, that spirits are not only not helpful, but are hurtful to the marching soldier, everywhere I believe, but nowhere more so than in hot climates. The

* The water at every station between Cape Coast Castle and the River Prah was carefully examined, and the best sources of supply selected by Surgeon-Major Gore.

evidence on this point is overwhelming. The Medical Officers of the French Army who have had great experience in the arduous campaigns in Algeria, denounce the spirit-ration as hurtful: and Dr. Morache, already quoted as a high authority on military hygiene, declares that unless coffee had taken the place of spirits, it would have been impossible for the troops to surmount the fatigues of what he justly calls *ces pénibles campagnes*. Were I the medical chief of an Army destined to take the field in a tropical climate, not a drop of spirits should, with my consent, accompany it, save what the requirements of the ambulance-service demanded. The evidence shows that wherever soldiers, by accident or design, have been cut off from the use of spirits on marches, on active service, in temperate climates exposed to wet and cold, or in the tropics to ardent heat, or in laborious sieges, they have maintained their health, spirits, and discipline far better than when the once-deemed indispensable grog was in daily use. My colleague Dr. Parkes, and the late Count Wollowicz, in a series of careful experiments on the use of alcohol carried on at Netley, and published in the Transactions of the Royal Society, have placed on a sure scientific basis what was before a matter of observation, and have established that alcohol, far from increasing the power of bearing fatigue, even when given in a quantity which many spirit-drinkers would deem within the limits of moderation, lessens muscular force; and a quantity in excess of this, it was shown, entirely destroyed the power of work. The reason, Dr. Parkes says, was twofold. There was in the first place *narcosis* and blunting of the nervous system—the will did not properly send its commands to the muscles, and the muscles did not respond to the will; and secondly the action of the heart was too much increased and induced palpitation and breathlessness which put a stop to labour. The inferences were "that even any amount of alcohol, although it did not "produce symptoms of narcosis, would act injuriously by increasing "unnecessarily the action of the heart, which the labour alone had "sufficiently augmented." For fatigue, rest and food are the proper remedies. Alcohol given alone under such circumstances can only stimulate the already nearly exhausted heart to fresh exertion. Under some very exceptional circumstances it may be a matter of absolute necessity to do this, but even then we must follow Dr. Parkes's rule, viz., to give spirits in small quantity, not more than an ounce of brandy, and if possible it should be mixed with Liebig's meat extract, which has a great power of removing the sense of fatigue. Dr. Parkes even gives a formula which is worth bearing in mind for use under such circumstances, as for example, when troops, after a fatiguing march, are obliged to engage the enemy without time for rest and food, he advises two ounces of red claret wine, with two teaspoonfuls of Liebig's extract in half a pint of water. Wine not being available, half an ounce of brandy or rum would be a good substitute.

I cannot leave this important subject without adding, that for twelve years at Netley, I have had unrivalled opportunities of studying the effects of habitual dram-drinking on the persons of our soldiers; and I add my testimony to the immense weight of evidence accumulated by medical men in civil and military life, to the effect that alcohol is one

of the most active agents in causing degeneration of the human tissues, in other words, disease, premature decay and death. If this be true, as I believe it is, those Officers who, by precept and example, strive to wean their men from the practice of this our national vice, may with truth be said to be engaged in a patriotic work, and to deserve well of their country. Let me ask you to look at this alcohol question from another point of view. I hold in my hand a copy of a work known, I dare say, to many present, viz., "The Sepoy War," being the Private Journal of General Sir Hope Grant, edited by Captain Knollys, R.A.; a modest record of very distinguished service. At page 108, we have the following passage, referring to the siege of Delhi. "In order to "fight to perfection, British soldiers must eat, and they must drink. "Would they drank a little less. There never appears to have been "any lack of provisions, and vast quantities of spirituous liquors "fell into our men's hands. Drunkenness became fearfully rife, "entailing with it increased sickness, as well as a relaxation of disci- "pline, which it was necessary to repress with an iron hand." We all know the stake played for at Delhi. It was the Empire of India. Mark how alcohol put the issue in peril. Mark also that from this danger we were saved only by that unrivalled power of maintaining discipline which British Officers have shown at all times, in all places, and under all circumstances.

Coffee.

It is almost superfluous to add that the best substitute for alcohol is coffee or tea. The French Military Medical Officers vaunt, and with justice, the superiority of the light wines of their own country over the more strongly brandied wines of Spain and Portugal, and they point to the fact, that when used in moderation, the aromatic principles and the various salts they contain, exercise an effect on the digestive organs which is alike wholesome and agreeable. With all this, the best of them give a decided preference to coffee. Morache, in particular, is emphatic in his testimony, and is even eloquent in its praise as an article of diet, a safe stimulant, an aid to digestion, and an efficient refreshment under fatigue. Coffee forms no part of the ration of the French soldier in time of peace; but Morache does not hesitate to urge its issue instead of brandy, and he instances certain regiments in which the custom of substituting coffee for the morning *petit verre*, had much advanced the cause of temperance.

That a cup of hot coffee is the best preparation for the fatigues of a march, is indisputable, and it should never be omitted. It is much better that the men should have it before leaving their ground, and not at the half way halt as was common in my time in India: it invigorates them at starting, protects, especially the young soldiers, against the griping abdominal pains to which they are subject particularly in the dark and chilly hour preceding the dawn, and the vigour it imparts helps the system to resist the miasm which at this hour is most freely evolved from the soil. It is worthy of remark that coffee was first issued to European troops for this very purpose,

on the advice of the great Larrey, during Napoleon's Egyptian campaign.

The chief enemies we have to guard against in tropical marches, are, malaria, dysentery, sun-stroke, cholera, and in the yellow fever zone, the terrible disease so named. Malaria is a poison given off by the soil under certain conditions. Dr. Parkes observes that "when "a country is said to be '*unhealthy*,' it is simply meant that it is "malarious."

Malaria is a product of organic decomposition in soils, it is banished by the cultivating hand of man, by drainage, especially sub-soil drainage, and by such a system of agriculture as directs the energy of the soil to the production of healthy living vegetation. The skill of the chemist has never yet isolated this poisonous agent, we recognise it only from its effects on the organism, which have been known from very early times. It is the chief factor in the causation of the class of fevers known as intermittent and remittent, characterised by a remarkable impress of periodicity, and by a long catalogue of sequels in the shape of organic diseases, which may also be gradually developed without febrile manifestations. It acts with the greatest intensity on the human system in situations which are low and moist, abounding in vegetation undergoing decomposition, in jungly districts during or immediately after the rainy season, at the base of great mountain ranges, as in the terrais of India, those belts formed of detritus rich in organic matter retaining a large quantity of water and covered with rank vegetation. It is capable of drifting along plains to a considerable distance from its source, and aided by currents of heated air, it can ascend ravines in mountain ranges to an elevation of many thousand feet. Water absorbs it, and periodic fevers can be introduced into the system by drinking water thus contaminated. This absorbing power of water is often beneficial when a sufficient breadth of it is interposed between human habitations and its source. Belts of trees in like manner exercise a protective influence. An important practical point to be kept in mind is that so slight an elevation from the ground as the difference between the ground and the second floor of a house often gives comparative safety; nay, the difference between the level of the ground and that of an ordinary bed may often lessen the danger. How high must we ascend to get out of its influence? Supposing there be no local sources, such as marshes, and no ravines up which it may drift, safety may generally be obtained at an elevation of from 1,000 to 2,000 feet. The point of safety differs however in different regions of the globe. It is hardly necessary to give such familiar facts, but without some such statement, the precautions to be observed in marching troops through malarial regions would not be intelligible. In India the ordinary reliefs of troops are made in the season of the year when comparatively little malaria is evolved from the soil. There are jungles, to enter which at certain seasons is, if not death, certain fever, of the most dangerous type; the same place can at the proper season be traversed in perfect safety. Under the pressure of military necessity troops must sometimes be moved at all risks. I have known this done when no such necessity existed, and with the most disastrous

effects. A General Officer whose name became in Spain imperishably associated with a regiment he had often led to victory, was in command in Madras when his old regiment landed; anxious to show favour to the successors of his old comrades, he determined that the regiment should at once occupy the pleasantest and most healthy station in his command. To effect this: another regiment then occupying it, must of necessity march more than 200 miles to a bad station in the midst of the rains through pestilential jungles. This was pointed out, with the inevitable consequences. The General was inexorable; the march was made, and when the condemned regiment reached its destination, a hundred sickly men were all that were capable of bearing arms, the rest were buried by the wayside, or were in hospital prostrated by fever, dysentery, and disease of the liver and spleen. For all purposes of service, the regiment was blotted out of the army list, until it was re-made, merely to indulge what was at best a bit of good-natured sentiment. A malarious district having to be traversed it should be done quickly. Night marches, always hateful to soldiers of all nationalities, are not under such circumstances to be thought of. In all climates they are to be avoided. They deprive men of repose at the time when nature most demands it, and for this nothing can compensate; they involve depression of spirits; even the light-hearted French soldier loses all his gaiety as he stumbles through the darkness; a night march is twice as fatiguing as one made in the cheerful light of day, and above all, it exposes the system of the soldier, at the time when it can offer least resistance, to the insidious attack of malaria, then given off in greatest abundance from the soil. In such localities, the afternoon should be selected; the men should be fortified by a good meal, and at least 3 or 4 grains of quinine, and an evening meal of which hot coffee should be a part should await them at the end of the march. The camping ground should be selected with care; should be in the driest available spot, not near ravines or any watercourses, and if possible, to windward of marshes, or any other obvious source of malaria.

The rules regarding drinking water already given, should be observed with more than ordinary strictness. The tents should be closed on the windward side, but kept open to leeward at night. Until the malaria-tainted district is traversed, halting days should be dispensed with. The tents should invariably be supplied with tarpaulin to spread on the ground, and Officers should see that the men have their blankets to protect them from the chill night and early morning air, which, charged with malaria, would otherwise certainly bring on fever, or dysentery, or both.

Officers can, without difficulty, carry with them their gauze curtains which they should use at night. The mechanical filtration to which the air is thus subjected is certainly, to some extent, a protection from malaria. When serving in China, I carried my own in the folds of my blanket, and invariably used them, even when sleeping in the open air in calm weather, thus securing, not only the advantage above hinted at, but protection from the attacks of insects—the well-known murderers of sleep in such regions. When with the Army of Exercise,

as it was called, assembled at Agra to coerce the Rajah of Gwalior, I well remember the surprise universally felt in camp on the arrival of the late General Sir Thomas Valiant, who, with his aide-de-camp, had traversed in safety the pestilential jungles which intervene between the Bombay frontier and central India. They owed their exemption from fever to double gauze blinds, kept closely drawn night and day, with which their travelling palankeens were furnished.

The length of marches in India is, on ordinary occasions—that is for the routine of the service—regulated by the Quartermaster-General's department, in communication with the Commissariat, who arrange with the District Civil Officers for the needful supplies. The march should average about ten miles, and on ordinary occasions should not exceed twelve. Sometimes, to escape camping in an infected or unhealthy locality, it may extend to fourteen miles. It is always, however, open to the Officer in command, on the advice of the Medical Officer in charge, on good and sufficient reasons by him shown, to modify the length of the march or change the camping ground, as circumstances may demand. Troops, under the guidance of Officers experienced in tropical service, have, however, when well fed and otherwise cared for, accomplished as much as thirty miles a day, and that for several days. This was sometimes done during the mutiny in Bengal; but the limit of human endurance is soon reached, if such a strain is kept up for many days. The 52nd regiment accomplished forty-two miles in twenty hours, part of the distance in the sun, marching ten miles more next morning, and engaging the mutineers at the end of it. Dr. Parkes, who records this fact, is careful to add, "that the "men were dressed in light and suitable clothing." Under the old tight-fitting uniform of heavy red "shoddy," I believe such a feat would have been impossible, without dropping half the strength by the way.

I have already said that night marches, from any point of view, are not advisable. All the French combatant and Medical Officers of Algerian experience are unanimous against them, save for good military reasons, to which every other consideration must give way. The practice of dividing the day's march into two, with a mid-day's halt, is not to be commended. It is unpopular with soldiers, who infinitely prefer being called on to make some extra exertion to finish the day's work. In India, the practice occasions much additional labour on those whose business it is to pitch and strike the tents. It is, moreover, prejudicial to the beasts of burden, interfering with their proper time for food and rest, and it soon tells on their health and condition.

Pace.

On ordinary occasions, if the end of the march is accomplished by 8.30 or 9.0 A.M., the troops need not be *en route* before 4.30. The marching pace is regulated by order in all armies. Nevertheless, I have often heard old soldiers on the line of march say, that the walking pace of the Adjutant's horse had a good deal to do with it. Halts at the usual distances are, in the tropics, of paramount importance. To such an audience, it is unnecessary to say that a regiment will

march faster than a brigade, a brigade than a division, a division than an army. Yet, in practice, forgetfulness of this well-known fact often leads to unnecessary exposure of the men. When the halt, which lasts from ten to fifteen minutes, is sounded from the front, it should be repeated rapidly to the rear; if this be not done, the troops in the rear halt just as the march is beginning again at the front. They are thus either deprived of their rest, or the continuity of the column of march is broken while they get it.

During these refreshment halts men may sit, but should on no account be allowed to lie down. This rule should be stringently enforced, when marching in the sun. During the French campaigns, so many men perished from sun-stroke while so doing, that Marshal Bugeaud published an order forbidding it. The reason, I suppose, is this:—A thermometer placed *on* the ground, in the sun in India, will mark 160° F., two feet *from* the ground it will stand 40° lower—an enormous difference. It makes a great difference whether the column marches in close or open order. So dangerous is the former, that the medical authorities in India long ago brought it to the notice of the highest military authority, and, except under a real military necessity, no experienced Commander would ever subject his men to the distress and danger inseparable from it in hot climates. Marshal Ney, indeed, declares it to be unsafe anywhere. I need not occupy your time by enforcing the necessity for personal cleanliness. It is of the greatest importance everywhere to see that men, young soldiers in particular, do not become footsore.* Non-commissioned Officers should be instructed to see to this important point, and by careful inspection to be sure that the under-clothing of the men is properly washed and well aired, more particularly on halt days, which should be allowed at least every fourth day, besides Sunday. If the families of soldiers follow their regiments, advantage should be taken of halt days to see that the country carts in which they travel and carry their luggage are unpacked, and their contents freely exposed to the air. Without this precaution, I have known them to become as unwholesome as some of the lodging-houses in our crowded cities.

Dysentery.

Dysentery has, time out of mind, been the scourge of armies. With

* The lecturer here showed a pair of shoes, and remarked—I hold in my hands a pair of shoes that I daresay would provoke the contemptuous laughter of a London bootmaker. Few of us would like to walk down Bond-street with them, and the Guards would object to parade in them for guard-mounting at St. James's. Nevertheless, they enabled an Officer to make the journey between Simla and the Thibet frontier twice over, without the wearer being foot-sore. They have been used also in pursuit of the mountain ibex, and have given a secure footing in places where the happy possessor of a pair of London-made boots, in a similar position, would be hurled from the line of eternal snow into an abyss 10,000 feet below. The "uppers" are made, you will observe, of the woven hair of the mountain goat, the soles of the untanned hide of the ibex, and sewn on to an elastic cushion of the wool of the mountain sheep. Notwithstanding the hard service they have seen, they are still as good as new. This is the shoe worn by the whole of the inhabitants of the Khunawur district, where a foot-sore man is never seen, and where a London chiropodist would starve.

good hygienic arrangements it ought to be a rare disease in modern times in well-regulated camps. Army surgeons of the present day are well instructed in the means of prevention, both in moving and standing camps. The measures already detailed all act in this direction. The grounds used for camping along the great lines of military communication should be kept with scrupulous care, and the severest sanitary police discipline should be enforced by every regiment using them, otherwise a privy-atmosphere, of all things most dangerous to health, will surround the place. The latrines for both men and followers should be carefully attended to, disinfected, and filled up as soon as the troops leave the place. It must be kept in mind that the excretions of dysenteric and cholera patients are active means of propagating both diseases, and no pains should be spared to prevent the camping grounds being soiled by them. Want of care in this particular in past times was a fruitful source of mortality. To be brief, cleanliness of place and person, temperance, good food, and good water, are the chief means of prevention; while marching in India, soldiers must sleep on the ground, but the tents should, I repeat, always be floored with good tarpaulin to prevent dampness, and, where possible, clean straw should be added, and the bodies of the sleeping soldiers, not overcrowded in their tents, should be protected from the chilly night wind.

What is called the cholera-belt should be worn by all soldiers. It is a great protection against the chilly air which invariably precedes the dawn, and which often brings on in young Officers and soldiers, severe abdominal pains, often followed by diarrhœa. The modern treatment of tropical dysentery is highly successful. The mortality among those treated by it is considerably less than one-half of what it was within my own recollection; but to be successful, this treatment must be early, and all Officers should give their cordial support to the Medical Staff in enforcing early application for aid on the first symptoms declaring themselves; and should impress on the men the disastrous consequences of concealment, and vain efforts to quench their sufferings by a recourse to such stimulants as they can command.

Sunstroke.

The next danger to be guarded against is sunstroke. Military reasons sometimes compel troops to march in the sun. It is to be hoped the day is passed for parades in heavy marching order in the hottest part of a hot tropical day, such as are to be read of in our Indian annals, with results that, little as they were thought of then, would in the present day raise a storm of indignant remonstrance against the cruel pedantry of those who ordered them.

I have elsewhere shown that men will bear a high temperature in the open air with comparative impunity, provided, 1st, it is not too long continued; 2nd, that the dress be reasonably adapted to the temperature and work to be done; and 3rd, that the free movements of the chest be not interfered with. Sportsmen in India know this well. It is impossible to exaggerate the importance of dress and accoutrements, not alone in India but wherever troops have to make long

marches in the sun. On the 6th of July, 1760, towards the close of the seven years' war, Frederick the Great marched from Kloster Marienstern to the Spree, to reach Silesia, if possible, before the Austrian Field-Marshal, Daun. The soldiers were dressed after the rigid Prussian method of that day, which I take to have very closely resembled, in all its important details, the equipment we have just discarded, which in fact was a copy of the Prussian system. Mr. Carlyle, deriving his facts mostly from the German military historian Archenholtz, gives a terrible description of this march: "The windless day grows hotter "and hotter; the roads are of loose sand, full of jungles and impedi- "ments. This was such a march for heat and difficulty as the king "never had before. . . . . The soldier, for his own health's sake, is "strictly forbidden to drink; but as the burning day rose higher, in the "sweltering close march, thirst grew irresistible. Crossing any of these "brooks, the soldiers pounce down, irrepressible, whole ranks of them, "lift water clean or dirty; drink it greedily from the brim of the "hat. Sergeants may wag their tongues and their cudgels at discre- "tion; showers of strokes, says Archenholtz, Sergeants going like "threshers on the poor men, though the upper Officers had a touch "of mercy, and affected not to see this disobedience to the Sergeants "'and their cudgels,' which was punishable with death. War is not "an over-fond mother, but a sufficiently Spartan one, to her sons. "There dropt down, in the march that day, 105 Prussian men who "never rose again. And as to intercepting Daun by such velocity, Daun "too is on the march; gone to Görlitz, at almost a faster pace, if at "a far heavier—like a cart-horse on gallop; faring still worse in the "heat, '200 of Daun's men died on the road this day, and 300 more "men were invalided for life.'"

On the 8th July, 1853, a body of men, 1,200 strong, marched from Beverloo to Hasselt. They started at eight in the morning. Only 500 reached Hasselt in the evening, 19 perished *en route*, and a great number, in a state of furious delirium, were taken into hospital.

The 43rd Regiment, during the mutiny of the Bengal Sepoys, marched from Bangalore in the Deccan to Calpee in central India, a distance, by the route taken, considerably exceeding 1,100 miles. With the exception of a few brief halts by the way of a few days at a time, the march was made continuously, a great part of it during the hottest part of the year; the men being exposed to a very high temperature by night as well as by day.

Dr. Barclay, the surgeon of the regiment, while in a valley at the foot of the Bisramgunge Ghat, observed the thermometer at 118° F., in the largest tents during the day, 127° in the smallest, and on one occasion he observed it at 105° at midnight. This terrible temperature and prolonged exertion, told with fearful effect on the men: long before they reached Calpee, they were reduced to the last extremity of weakness. When at the foot of the pass just named, cases of insolation were brought to the hospital tents at every hour of the day and night, and although a large proportion of them were recovered by prompt treatment, two Officers and eleven men died in one night and were buried under one tree in the neighbourhood of the camp. I could

multiply examples of the terrible power of the sun on soldiers in the field; the above must suffice. Examples of these gathered from the medico-military and naval annals of our own and other countries, I have given in the article "Sun-Stroke," in Russell Reynold's System of Medicine. But I cannot miss the opportunity of warning those inexperienced in tropical service, of the great danger of crowding soldiers in barracks, tents, or even ships at sea, in hot climates; direct exposure to the sun's rays is not the only way in which high temperature kills; it is often quite as fatal in the close ill-ventilated and crowded barrack dormitory, tent, or the main deck of a ship, as under the rays of a vertical sun. This suggests the question whether it would not be safer in such circumstances to dispense with tents altogether, and make the men sleep on the ground, or on such raised beds as they can extemporise from the materials at hand. No one can be more impressed than I am with the great danger under such circumstances as we are considering, and indeed any circumstances, of causing men to breathe the foul air of a crowded and ill-ventilated tent, and as the least of two evils I would sanction a bivouac in the open air rather than expose them to it. At the same time I must add, that so far as my experience goes, chiefly gained in India, it is opposed to the general practice, and in localities notoriously malarious, it is I am sure unsafe. I must only note here, in passing, a curious peculiarity in the behaviour of Frenchmen when under the influence of high temperature; viz., a disposition to commit suicide, seamen by throwing themselves into the sea, soldiers with their arms. In one of Bugeaud's marches in the province of Oran, 11 men destroyed themselves, 200 on the same march suffering from insolations. The thermometer taken alone, does not always indicate the danger. There are other facts not as yet very well understood, such as the nature of the soil on the line of march, whether or not it be covered with vegetation, the hygrometric condition of the air, its electric tension, and the state of health of those exposed. I have already sufficiently adverted to the effects of dress and accoutrements, the weights the soldier has to carry and the mode of carrying them.

What then are the precautions to be observed to minimize as far as may be, the dangers above indicated? They are briefly, loose and light dress, protection to head, neck, and spine, and, let me add, the abdomen also. I am informed by one of Dr. Livingstone's companions in his African travels, that they were all as solicitous to protect this region of their persons from the heat radiated from the soil, as their heads from the direct rays of the sun. For this purpose they used waist belts made of bunting, *white*, when they had it.* Anatomists and physiologists, remembering the position of the great plexus of the sympathetic

* The lecturer here remarked on the necessity of making that part of the cover of the soldier's cap, which protects the nape of his neck, not of one, but of many folds of white cotton cloth, which should come lower down on the shoulders than it usually does. He also produced a waist-cloth or Kummerbund, of the finest Rampoor shawl cloth, 30 feet in length, so light and flexible as not to incommode the wearer, and yet to give perfect protection to the abdomen. He also pointed out the universal use of this among the natives of India.

system of nerves, will understand the *rationale* of this precaution. Marches of moderate length, in open order and with frequent halts, the men being allowed to sit, but, for the reason already given, not to lie down. Personal cleanliness, an abundant supply of the best water procurable, for drinking and douching purposes, good food, and tea or coffee, instead of spirits, for refreshment. On one of the last occasions when Canton was occupied by British troops, there was an alarm at noon day, and the troops had to turn out. An Officer in command of a battery, thinking to do his men a kindness and to "fortify them" against what was before them, opened the canteen and gave each man a glass of spirits before starting; that battery had more cases of sunstroke than all the rest of the force put together. Is it then advisable to drink water when exposed to the sun? With a good intention no doubt, the Great Frederick forbade this indulgence to his men, and we have seen what came of it. All sportsmen know that if they once begin to drink water, on the moor for example, obeying the first craving for it, they must go on so doing all day. If they resist, the inclination passes away, and they go on without suffering until they reach the luncheon basket by the side of a cool spring. This, however, is a different case from that of the laden soldier toiling in the ranks along a dusty road, half choked with dust, and sweating profusely. Water is then a necessity, and men, like the hart "heated in the chase," "pant" for it. The blood is every moment becoming heated, and but for the cooling effect of the enormous evaporation from the skin, would soon become super-heated, with effects fatal to the centres of nervous energy and power. It is parting also with its watery constituents, and nature cries aloud for its renewal. To withhold it under such circumstances is as stupid as it is cruel.. It will surprise those who have no experience in such matters, that in sun-stroke the temperature of the human body will sometimes reach 110° F., that is within 3° of a temperature at which the albuminoid constituents of the muscular system coagulate, and late researches have shown that the sudden failure of the heart's action in some forms of sunstroke may be due to this very occurrence. This will explain why the modern treatment of insolation is mainly based on the rapid reduction of temperature.

Cholera is our next subject. During the greater part of my service in India, the belief prevailing in high quarters was, that cholera was like the wind "blowing where it listeth;" that nothing was known or could be known as to its origin, its movement, its propagation; it was felt to be a frightful evil, one that as it could not be cured, was to be endured. So long as this state of mind continued, measures of defence or precaution were deemed as futile as an attempt to get to the back of the north wind. If cholera was known to prevail along the route about to be traversed by troops moving both ways in the course of the usual reliefs, that was not considered a sufficient reason for interfering with the routine of the service. One regiment was sent on the track of an infected one (already carrying the disease from village to village along its route), occupying the same camping ground, soiled with the poisonous discharges from the persons of the sick. The whole atmosphere was tainted with the stench of the bodies of the wretched followers,

always furnishing the largest number of victims, torn from their shallow graves by obscene beasts of prey; but enough of this past, fruitful in scenes of horror on which I seek not to dwell. This was pre-eminently the pre-sanitary age. There is enough of mystery about cholera still; its exact cause we do not know, it may be we shall never know it. It may in the future, as it has in the past, elude all the most refined methods an advanced science can bring to the enquiry. For some years past many ardent minds have sought to look into this mystery in vain. Two young men in particular, singularly gifted with the philosophic spirit, and armed with all the means science can supply, were set apart for this honorable but dangerous service by the Professors of the Army Medical School, with the approval of the Home and India Governments; Drs. Douglas Cunningham and Lewis have laboured in this cause, and although their labours have not been unfruitful, and are still full of promise, nature has not yet been forced to yield her secret to the persistent enquiries of these young philosophers. For all this, we do not despair; and even if we are destined never to see the veil withdrawn that hides the mystery from our eyes, we believe that in time we shall learn how to restrain the ravages of this disease within narrow limits, if not to stamp it out altogether. We now know with some exactness its birth place, or, in the language of Dr. Bryden, an eager labourer in this field of enquiry "its endemic "area," whence it starts on its "tours of invasion." The laws governing its movements are being patiently examined, the means by which it is propagated from man to man, and from one congregation to another, are being sifted and recorded, and although on such points there is much conflict of opinion, I am confident the truth will appear at last "with healing on its wings." Already the enquiry has not been unfruitful in important results. Four times in the course of last year did cholera effect a landing on our shores, in London, Liverpool and Southampton, from foreign lands where it widely prevailed, and on every occasion the energetic efforts of the local sanitary authorities stamped it out before it could establish itself in its old haunts, and carry death to thousands of our countrymen.

To make intelligible the precautionary measures I am about briefly to give, I repeat here what I have elsewhere written. From the carefully observed and recorded histories, not of one, but of many epidemics of cholera, not in India only, but in every country yet invaded by the disease, I believe that human locomotion is the means of its extension from one distant place to another; in other words, as Dr. Netten Radcliff has expressed it, "Cholera does not travel, but is "carried;" while air and water are the main agents of its diffusion in the vicinity of a place into which it has been brought, aided often by the agency of infected clothing, bedding, or whatever has been contaminated by the excretions of those affected by the disease. Let this most pregnant fact, well insisted on by Simon, be kept ever in mind, viz., that where cholera is epidemic in any place, persons who are suffering from the epidemic influence, though, perhaps, with only the slightest degree of diarrhœa, may, if they migrate, be the means of conveying to other places an infection of indefinite severity. That

the "quality of infectiveness" is in the matters which the patient discharges, that if these matters undisinfected are permitted to mingle with the contents of drains or cesspools, the very effluvia from them may infect; finally that if the cholera contagion from the above or any like sources, gains access to wells or other sources of drinking water, it will infect large volumes of the fluid. With regard to infected clothing here is a well-authenticated fact. Towards the close of the last epidemic of cholera in Malta, a woman in attendance on a soldier's wife affected with the disease, purloined and secreted an article of under-clothing worn by the sick person; weeks after the death of the woman, and after the disappearance of the disease from the island, this unhappy creature put on the stolen garment, without washing or disinfecting it, caught the disease and died. In like manner washerwomen who have had to wash the linen of infected persons without previous disinfection, have thus caught the disease.

It was long one of the "mysteries" of cholera, that it often localised itself in a particular house, a particular block of barrack buildings, one side of a street, and so on. The "mystery" is frequently explained by a careful inspection, disclosing local sanitary defects, a tainted water supply, and in some exceptional instances, even tainted food. I well remember one block of barrack buildings at Arcot, in the Madras Presidency, a very cholera-haunted station. It was on a much lower level than the main body of the buildings. To one division of this block in particular the disease, so soon as it appeared in the station, returned with the regularity of the swallow. At last, the floor of this pest-house was dug up, and a drain, choked with frightful accumulations, was discovered, the existence and direction of which had been forgotten. The barracks were built in the days of Clive, when Arcot was a place of importance, and, in their construction, every principle of sanitation had been violated—in nothing more than in the direction of the drains, driven as we have seen through the very centre of a dormitory. Bearing the above facts in mind, let me urge, first, that troops should not be marched into an infected locality, or tainted district. By way of illustration, take an historical example "written for "our learning," what is known as the Mhow Case. A detachment of artillery, with women and children, was ordered to march from that station to Poonah. It was reported to the General commanding the division that cholera prevailed on the route, and delay was urged on this ground. It, unfortunately, happened that this Officer, on a previous occasion for a like good reason, had delayed a movement of troops, for which he received a rebuke from head-quarters. Unwilling to expose himself to another, he allowed the detachment to march, which in due time entered the "tainted district." All the world knows what followed. A shocking mortality among men, women, children, and followers. The time had gone by when such untoward events could pass without notice. A great outcry arose all over India. It reached this country. The facts were commented on by the press and discussed in Parliament, and after an acrimonious correspondence between the General and the authorities, he was deprived of his command.

2nd. When cholera attacks in cantonments or on the line of march,

change of locality is a point of primary importance. Flight out of the tainted place is not left to anyone's discretion; it is now a standing order in India. The Shakesperian maxim, "stand not on the order of "your going, but go at once," should be the rule of conduct; go, ere the men get tainted; go, before they become depressed and panic-struck, by the rapidity with which the disease carries off its victims. The move should be made to the driest soil, where cholera victims have not been —where, as Dr. Parkes puts it, "it is pure, impermeable, and un- "contaminated."

3rd. It is advised, when overtaken by cholera on the line of march, to move at right angles to the line of the prevailing wind. The plan may be tried—it sounds very reasonable—and if it be true that cholera germs or dust are carried to great distances by the wind, it ought to be effectual. Knowing however, as I well do, that cholera takes little account of the wind, finding its way, as I believe, by human means, not much hastened by a favourable, or much delayed by a foul wind, I do not personally think much of the measure. Others, however, whose opinion is deserving of respect, think differently.

4th. If a tainted village be on the way, avoid it; and, above all, if a body of tainted troops be approaching, it must not only be avoided, but the ground they have encamped on, being highly dangerous, must not be even approached.

5th. If a river be in front, cross it quickly. Do not linger on its banks, for the disease evinces a dispositon to cling to rivers, which is probably only another way of expressing the fact that it follows the course of human intercourse.

6th. Need I repeat once more all that I have said about jealous watchfulness over the sources of water supply, and the necessity of the careful purification of it? To the next and last point I attach the greatest importance, viz., frequent inspection of the troops, at least three times a day, by Medical Officers, to pick the men out in the first stages of the premonitory diarrhœa. The eye of the experienced physician will detect at a glance the tainted man, before he has a suspicion that anything but a painless diarrhœa affects him. This is the stage when treatment avails; check this at the outset, and the man is saved.

It is needless to repeat once more, that attention to the conservancy and disinfection of latrines is more necessary in this than in all other diseases which may attack troops in camps or on the line of march.

Yellow fever is the next and last subject to be briefly noticed. This terrible disease has a *habitat* of its own, viz., the shores of the Gulf of Mexico, and the northern and eastern shores of South America, and the islands of the Caribbean Sea. From this, its home, its "endemic "area," it has often been imported into other regions with destructive effect, but has never established itself in any of them as an endemic disease. Unlike cholera, which can live and thrive at St. Petersburg as well as in Calcutta, yellow fever loves a hot climate; there is much evidence to show that it has never established itself in any climate

where the average temperature is below 72° F., and the late Dr. McWilliam, of the Royal Navy, one of our highest authorities on the subject, has shown that it is driven from the coast of inter-tropical Mexico between the months of November and March, when the mean temperature does not exceed 71° F. Humboldt was of opinion that yellow fever cannot exist at an elevation of 3,000 feet above the level of the sea. But the truth is that it has three times been imported into the mountain military station of Newcastle, in Jamaica, where, however, I must add, a most efficient *nidus* had been prepared for it by faulty sanitary arrangements. Again, cholera destroys men of all races with perfect impartiality. From some peculiarity in the organization of the negro race, they enjoy a certain degree of protection from yellow fever. Our Army records show this incontestably; the mortality among the black troops is as nothing compared to the whites from this cause. I have called your attention to the fact that cholera often operates in a limited area or "tainted district." One of the most fortunate circumstances connected with yellow fever is, that this is, in a much higher degree, one of its distinctive peculiarities, and I invite attention to it as of the highest practical importance to military men, as on it is based the chief measure of precaution. I have not time to give a brief summary of the evidence on this point, but from the earliest examples with which I am acquainted, down to that of the Lisbon epidemic, the different invasions of the terrible outbreak at Buenos Ayres, and that of Shrieveport in the United States, the disease has evinced no disposition to extend the area of its operations beyond the tainted district. The lesson this teaches us all is that in flight we must seek safety for those committed to our charge. At Buenos Ayres, safety was found a few miles outside the city; it was the same at Lisbon, and at Shrieveport; and Blair of British Guiana, who has written one of the best treaties on the disease, has recorded the same fact.

Whatever be the exact cause of this pestilence, which is as yet as obscure as that of cholera, one fact of primary importance stands out clear as noon day. It is emphatically a child of dirt; or, if this be going too far towards its filiation, an atmosphere of dirt is that which it loves and affects, and within which it confines itself. So long as New Orleans was an uncleanly city, yellow fever was an annual visitor. Whatever we in this country may think of General Butler, however little most of us would like to live under his rule, he did one thing for New Orleans, he vigorously enforced sanitary laws, and for nine years that city has enjoyed an exemption from the disease, a thing unknown in its previous history. Most of us know, by hearsay at all events, that Lisbon is not famous for that which is said to be near of kin to Godliness; Buenos Ayres, when at last, notwithstanding its attractive name, yellow fever was imported into it, was nothing but a network of enormous cesspools. The streets were covered with swill and offal. The water of the river was so affected by the fluids that drained into it, that fish died and were thrown upon the banks. The people drank the water, and met the same fate; Shrieveport was much in the same condition; and when yellow fever entered, a New Orleans physician

declared, that all who were seized with it dropped off like sheep seized with the rot.

Surely I need not point the moral?

Yellow fever is a disease with which our naval brethren have more to do than we have, now that so few troops are serving in its *habitat*. Naval Commanders and Surgeons know that when boarded by this unwelcome visitor, there is but one course to pursue, viz., to shape one for higher latitudes; and the sooner this is done, the better for the safety of the crew. In one word, by sea or land we must seek for safety in timely flight. This is a case in which discretion is certainly better than valour.

And now to conclude. It will be seen that I have not so much sought to lay down hard and fast rules; to say, "do this," and "don't "do that," as to establish principles from which precautionary measures flow as their corollaries. In other words, within the narrow limits, of necessity assigned to me, I have given you, in merest outline, it is true, a sketch of the natural history of the diseases which assail us in tropical climates, in the belief that this is the true way when addressing educated men to teach them how to meet and disarm them. This is not the ordinary vestryman's view of sanitation, and let me add, of those who act as if they deemed the conciliation of vestrymen of more consequence than national health. To such, given any unsanitary condition, and it is, in their opinion, "the toss of a half-penny," whether the outcome be small-pox or "fever," under which term they lump up half-a-dozen diseases specifically different in their cause, their symptoms, their anatomical lesions, their portability, their treatment, and mortality—cholera, or any other item in Pandora's box.

I am thankful for the progress we have made, I am hopeful of conquests yet to be achieved by preventive medicine at home, abroad, by sea and land; but I cannot withhold the expression of my belief that until the vestryman's "view" of sanitation ceases to influence the minds of those who aspire to direct public opinion and to guide legislation on this subject, the cause of what our continental neighbours aptly call "State Medicine," and with it all that belongs to the health of fleets and armies, will not take the place in the administration of affairs, its importance in relation to the happiness and well-being of our country, demands.

The CHAIRMAN: We have listened to a very interesting lecture upon a very important subject, and one which involves not only medical but military points. As the Sanitary Schoolmaster has been abroad so long, not only in private life but also in the Army, perhaps some officers or gentlemen whom I see present may be disposed to offer some remarks upon the points contained in the lecture.

Captain LUARD, R.E.: There are one or two points in the lecture that, with your permission, sir, I will comment upon. I think the most remarkable point was with reference to the height above the sea at which camping stations and garrisons should be placed, and this bears more especially on our position at the present time on the Gold Coast. We have been maintaining garrisons all along the Coast in positions which we know are not sanitary; but the probabilities are that, in future, stations could be selected on that Coast where troops could remain without any chance—or at least with much less chance—of their suffering from the terrible climate. We know that in the district of Akropong there are hills and uplands varying from

1,000 to 1,500 feet in elevation. The probabilities are that, if the troops were concentrated in that part, they would still be able to maintain a military control over the whole Coast. There is nothing, probably, from which soldiers suffer more than from drought, and anything which would tend to preserve them from thirst during campaigns and during marches is of the utmost importance. The lecturer commented on a beverage which he strongly recommended to troops, and that was coffee. Now some years ago I was hunting chamois in a very hot season of the year, and it was a most important thing to ascertain what was best to drink. We tried coffee and tea and cocoa; and my friends and I were unanimously of opinion that cocoa was far superior in enabling us to resist thirst to anything else. The use of spirits was entirely, as I understood, tabooed by the lecturer, but I would ask whether a very slight modicum of spirits mixed with the cocoa or coffee would be hurtful to the troops. My impression has been that although raw spirits are undoubtedly very bad for men, injuring the coats of the stomach, yet, mixed with soup or coffee, they are not deleterious in their effects, and are occasionally beneficial.

Sir WILLIAM CODRINGTON: There is one matter with regard to the clothing of troops. As long ago as 1842 I think, the Government gave to every soldier in Canada his fur cap and his mocassins at a cost of £3 to the country as an addition to his kit.

Dr. MACLEAN: What I had particularly in view was this, my colleague, Mr. Longmore, professor of Military Surgery at Netley, who served with the 19th Regiment in India, has often told me—in fact it is now in print—that he took the trouble to weigh the clothing sent after the regiment to Calcutta, which arrived in the dog-days to be served out to the men; he found that it was actually heavier than the clothing which had been issued to his own regiment whilst serving in Canada. Of course I did not allude to the external clothing superadded to that, but merely to the ordinary dress. In the case of the 19th Regiment, that certainly was so—the clothing served out in Calcutta, weighed more than that which had been issued to the same regiment in Canada.

Sir WILLIAM CODRINGTON: I imagined that you mentioned there was no change in the dress in Canada.

Dr. MACLEAN: I was referring to the ordinary uniform, not to great coats and such like additions.

Mr. G. W. COCKBURN: If not intruding on the meeting, I would support what the lecturer said about the unadvisability of commencing to drink in hot climates, and how well I know the truth of his assertion that every true sportsman knows the danger of commencing to drink, in hot climates. I think we may learn a great deal from the natives of those countries; and I can also speak from experience, having kept the fast of Ramazan with a certain Mussulman regiment in India, who urged the fact that they were keeping the fast, against doing any work. I accordingly kept the fast myself with them, so that I might say "I am keeping the "fast myself, so we will go along together." The fast was kept from the first dawn of day until sunset; and the abstinence from drink was much more difficult to bear in the hot weather than the fasting from food. No Mussulman, as soon as the sun sets, thinks of quenching his thirst by taking a drink first; but he takes a small piece of salt and eats it, and he always takes a bite of food of some sort. The necessity of doing this should be always urged on our troops, whenever they halt, viz., to eat a little before they drink, as then the drinking will not bring on that fearful thirst, which, even the purest spring-water in the Himalayas will do, if you once commence to drink. If you commence to drink very early in the day, you will have raging thirst all the rest of the day; but if you resist that temptation to drink and take a small mouthful of food first and then drink afterwards, the effect is very different. I learned this very notably on a certain long march in a region I have no doubt well known to the lecturer, to the top of the hill near Simla. I was very anxious to get there in a very short time; and, before starting, an old lady had told me that gingerbread nuts were a great thing to keep down thirst, and insisted on my putting some in my pocket. I laughed at the old lady's story and did not believe in it at all. The following day we had to start at two o'clock in the morning. I got nothing to drink; and marching in the month of May, although in the hills, is extremely hot work in the sun. I had a bottle of cold tea, which I would not touch myself, because if the

men had seen me doing it they would have said that I was drinking and they were not, and would have made that an excuse for any further advance. I was very nearly dead with thirst at one time, when I thought of these ginger-bread nuts. I put a small piece of one of them into my mouth; I found to my astonishment that I went on with perfect ease afterwards. This is an old woman's recipe, but it is a very good one; and if the soldiers were furnished with ginger-bread nuts or a biscuit on these long marches and told to eat a small piece of that before they drank, I will guarantee from my experience, that drinking would not have the same effect of bringing on a raging thirst.

Mr. RAWLINSON, C.B., C.E.: I hope I shall not be obtruding myself upon this meeting, this being a medical question, for I can only speak upon it from an engineering point of view; but I may, however, speak with some experience, seeing that I have been one of the Inspectors of the Board of Health since its formation in 1848, and that I had the honour of being appointed engineer to the Sanitary Commission sent out to the Crimea (1855). With regard to provision to be made for armies on the march, I am not going to occupy your time with any story of my own about that. I would simply supplement some of the lecturer's remarks with regard to the care that is necessary; and I will state briefly some regulations that I found neglected in the Crimea. I am speaking in the presence of Sir William Codrington, and I simply wish to explain certain regulations which I considered necessary, but which were neglected. The water supply of the camp at the front was obtained from natural springs and from ruined wells. The natural springs at the beginning of the second summer were in a muddy condition. There had been no attempt made to store the flow for 24 hours. The men drew water indiscriminately as they could get it. There was no regularity in the order of drawing, but each man drew as he went to the spring, the result being that the water was muddy from morning till night. It was the same with the wells. They were also drawn from indiscriminately from morning till night. The water slopped over the bank, went back again, and so contaminated the water. It did seem to me that it was so easy to remedy that state of things that in future it ought never to exist; as that whenever an army occupied a country, even for a brief space, the first thing to be done should be to put a guard upon the sources of water supply, and that the drawing of the water should not be done by the men individually but by orderlies told off for this purpose, and that some simple tank expedient should be adopted to economise the water for 24 hours. With regard to the watering for the cavalry camp, there were some 12,000 horses, and there were rows of watering troughs erected for the horses to water from—ten or twenty in a row; the water was run into the top trough, and then fed into the next, and into the next, and so on, the result being that before the water got half way down, the horses coming to the lower troughs would not drink it. This might have been obviated by a very simple expedient, for a small trough-spout or pipe might have been carried down in a line with the row of troughs with a small feed into each trough which would then have given an independent supply without its passing through any second trough.

With regard to the huts sent out to the Crimea, the roofs were covered with patent felt. Unfortunately for the soldiers, felt being waterproof was also air-proof, and no adequate provision had been made for ventilation. That was, however, sought to be remedied in different ways by the different medical officers of the different divisions; but I do not think any of the plans were entirely successful. The remedy that we recommended (and which was carried out) was to cut a slit in the roof, and then to cover it with a louvre-board raised about an inch above. If in the huts sent out to Africa the same form of roof has been continued, and that remedy has not been provided for giving ventilation, those huts may afford shelter to the men, but they will, at the same time, breed fever. So much was that the case, that some huts in the Crimea were emptied, as every man went down with fever when they were kept at the full charge of 25 men to each hut. With regard to cholera and what may cause cholera that is a question I am not going to enter into, excepting so far as to state that it has been my fate to examine almost every seat of cholera in this country, and whatever may be the cause of cholera, as the lecturer has remarked, it cannot be said (independently) "to travel," or "to jump," or progress in other similar ways described in many, even medical, reports, such as "passing mountains,"

"running up rivers," and "marching over plains." It requires human intercourse. It follows the human being; it is attached to him; but there may also be something else besides the human being to cause cholera. After investigating one site of cholera after another in this country, and thinking "Now I have found something about it; now I know something about it," I was driven from every post—one after another —and had to come to the conclusion at last that I really knew nothing about it, except that it had an affinity for dirt. There was the instructive case of the town of Alnwick. The medical officer there jotted down upon a map every case of cholera and of cholera death, and in looking over the map and examining the ground I found that cholera had fastened upon the site where the back land drained into and through the basement; where the houses built upon the slope had the fall away from them, they were exempt. At the backs of the houses were great heaps of ordure and refuse, and the sub-soil becoming tainted beneath the basement, the atmosphere of the interior had become contaminated with foul vapour. As to cholera crossing a river, the lecturer has explained that there was a large traffic of human beings on the one side and little or none upon the other. I remember a French commission inquiring into the cause of cholera, and it came to the conclusion that cholera did not prevail upon the granites. I said, "Have you much population in France upon the granites?" "No." "Then, how can it prevail there?" I said. One of the most severe cases we had in England was upon granite. It was at Megavissy, in Cornwall, where one-tenth of the inhabitants died in a month; so that stratification has little to do with cholera. With regard to clothing conveying cholera, and with regard to the notion of woollen garments being specially impregnated with virus, let me tell the lecturer one fact. At the time I was Chairman of the Rivers Commission I was holding an inquiry in Yorkshire where the manufacture of shoddy was first perfected. I had before me medical men who remembered the introduction of shoddy, which is old woollen garments, gathered from every dirty quarter of the globe—Egypt, Poland, &c., to the extent, that year, of 35,000 tons of shoddy, and principally into that district. I said, "Have you disease when you break open these bales and handle these woollen rags?" "Not one single case." I said, "Are you quite sure?" "Not a single instance within our knowledge." There was an experiment upon a gigantic scale, whether or not the virus, or whatever it may be that impregnates woollen clothing, for I am not going to say that a woollen garment taken from the back of a cholera patient and immediately put in contact with another, may not carry the disease, but whether length of time or ferment destroys the virus, and how long it takes to do so, is really a question well worth inquiring into. Inquiry has been made with regard to small-pox and linen rags, and the commission found that there was only one small paper manufactory where small-pox had broken out, and there the commissioners could by no means fasten the outbreak upon the linen rags.

With regard to water and cholera, I know something about the water supply of India. Having the honour to serve upon the Army Sanitary Committee, it is my fate to glance over the reports from every part of India, and that cholera should prevail in India, that fever should be rife in India, and disease in excess, need not astonish any person who will take the pains to look at those reports. Anything more abominable, more horrible, than the water supply of India generally cannot by any possibility be conceived. Many of the wells are so tainted by the water filtering in from the tainted sub-soil as to be utterly unfit for any form of use. And again, the Hindoo has a ready facility of committing suicide, and in one of the provinces it was found that in one year some 1,700 bodies had been taken out of wells and tanks used by the inhabitants of that district. Attention is now turned to it, and analyses have been made by hundreds, I may almost say by thousands, and means are being taken to improve the water-supply of India, and as that improvement takes place, I have not a doubt but that the mortality will be reduced. I entirely agree with the lecturer as regards the use of spirits, and I am delighted beyond measure to hear him denounce any use of spirits as a ration for soldiers in the field. I am fully satisfied that doing away with the use of spirits both for our Army and Navy (other than as a medicine), will be one of the greatest improvements.

Sir W. CODRINGTON: I may mention that it was in times of great difficulty that the Sanitary Commission came out to the Crimea. There was the difficulty

of getting up huts, the difficulty of getting provisions, and the difficulty of getting water. I think that these things have not been quite considered in the statement that has been made to-night by Mr. Rawlinson. (Mr. RAWLINSON: I did not wish to cast any censure.) I do not mean that at all.

Mr. RAWLINSON: I only say, if I had to do with an Army in the field, a well or other source of water should never be left to be indiscriminately drawn from, as was the case in the Crimea; there ought not to be a single case of it in future.

Dr. MACLEAN: I have really very little to say in reply in addition to what I have already said. I believe I am quite at one with the gentleman who has just addressed us on so many points connected with sanitary matters in India, and more particularly with what he has so forcibly stated with regard to the water supply there. I did not go into all the details, but I am thoroughly acquainted with the truth of the facts that he has just stated, more particularly what he referred to just now with regard to the enormous number of suicides, particularly of women, in the wells and tanks of India. In the place where I myself did duty upwards of eleven years when I was attached to the Residency at Hyderabad in the Deccan, in the wells of the immediate vicinity of that great city, suicides took place in the way described by Mr. Rawlinson at the rate of three or four a night and frequently more. I would wish also to observe with regard to what was said about the non-introduction of cholera by shoddy that the instance I gave of the disease having been transmitted from one person to another, was exactly such a case as Mr. Rawlinson allowed might possibly be an exceptional one. This garment had not only been used by a person sick, but was tainted in the way in which you might naturally expect, and it had not been exposed to the air until it was again used and in that way we can very well understand that the germs of cholera or whatever you may choose to call them may have retained their vitality.

I should merely like to add that the blanket that you see before you, formed the side walls of a tent used by the Officer whom I have previously mentioned. The tent was in use for upwards of ten years, in very unhealthy localities, in the deep valleys of the Himalayas. The blanket was found to be capable of resisting any amount of rain, and, when exposed to the severest tempests, the tent was perfectly dry, and—what was noticed as a thing of very great importance—it also acted as a mechanical filter to the air; and the gentleman and his wife, who inhabited it for many years, never suffered from malaria. It is a notable fact that the people who live in the district I have mentioned, when they are obliged to sleep in malarious regions, invariably use a sort of mask made of the same material, though somewhat finer; having been taught by experience, the immense importance of filtering the air and thereby protecting themselves.

The CHAIRMAN: I am sure you will allow me to return your thanks to Dr. Maclean for his very interesting lecture, in which he has laid down maxims that may act as guides for the future. A more able or more philosophic lecture we could not have had, and I have great pleasure in conveying your thanks to Dr. Maclean.

LECTURE.

Friday, February 13, 1874.

ADMIRAL SIR R. SPENCER ROBINSON, K.C.B., in the Chair.

ON THE VENTILATION OF SHIPS, ESPECIALLY OF LOW FREEBOARD, AND HOSPITAL SHIPS.

By JOHN DENIS MACDONALD, M.D., F.R.S., Staff-Surgeon, R.N., Assistant-Professor of Naval Hygiene, Netley Medical School.

ON the nomination of the Director-General of the Medical Department of the Navy, and with the sanction of the Admiralty, I have undertaken to deliver a lecture, to the members of this Institution, on the subject of "Ship Ventilation"—a subject which has always been an important one to our Navy, but is more particularly so at the present time, arising from the rapid and extraordinary march of the science of naval architecture of late years, in keeping with the requirements and exigencies of modern warfare.

I presume then it will be quite unnecessary to take up much of your time with preliminary remarks on the hygienic value of wholesome, fresh air, or recall to your minds the catalogue of evils incident, either to its inefficient supply or to its vitiation from any cause. This being conceded, I shall proceed at once to the review of principles, and of such systems as may deserve special notice, referring to any historical matters of interest connected with them; and finally, make some few observations, suggested by the study of the subject, which, I venture to hope, may be of practical utility.

It is usual to divide the sources or means of ventilation into (1) Natural and (2) Artificial.

To the natural category belong, first and especially, the prevailing winds and other aerial currents, which should be aided by wind-sails and air-shafts; and, secondly, those local differences occurring in the specific gravity of neighbouring columns of air, arising from the operation of existing or ordinary conditions, which should be favoured by a suitable arrangement of conduits and uptake cowls.

The artificial means being quite analogous to the natural, may be divided in a similar way, viz.:—first, mechanical propulsion, by rotatory fans, &c., establishing in-, or out-going currents, as the case may be; and, secondly, extraction by heat, applied artificially, and acting through special channels. In addition to these leading principles, we must pay due attention to the ceaseless action of the law of the diffusion of

gases, which is too frequently overlooked by those whose acquaintance with the resources of mechanics may be competent enough in the abstract.

The expansibility and elastic property of common air may be regarded as its intrinsic cause of movement, so as to afford in it an interesting contrast with the blood of animals. Thus the blood, as an incompressible fluid, is circulated through the animal economy by means of the combined contractility and elastic force of the heart and vessels in which it is contained; but the air which it is our object to renew and circulate in circumscribed localities is, in itself, quite elastic and compressible, while the walls of the channels by which it enters or finds its escape, are usually rigid and unyielding. Its elasticity and expansion, moreover, increasing as they do with the temperature, the tension thus induced will naturally render it mobile, so to speak, and determine its movement in that direction in which it finds the least resistance. Here, then, we have an explanation of the ascensional tendency of air contained in the openings between the timbers of wooden ships, or in laterally confined spaces, with an elevation of temperature. Thus, when no aspiratory or propulsive force is in operation, an updraught will be produced by an increase of temperature with a concomitant increase of volume in one portion of air as compared with another in its immediate vicinity. This ascensional force, resulting in ordinary as a spontaneous effect, may be assisted or directed by artificial means, such as the systems proposed by McKinnell and Watson, or the cause itself may be further developed by the direct application of heat, after the system of Sutton, who, availing himself of the galley fire, turned an existing source of caloric to the most economical account.

McKinnell's tube within tube, and Watson's tube divided by a longitudinal septum, as in the shafts of mines, are but slightly different applications of the same principle, the currents passing in opposite directions being concentric in one case, and side by side in the other. They are both intended to favour natural ventilation.

The system of Sutton, on the other hand, is more definitely artificial, heat being specially employed to effect an extractive movement of the air requiring to be withdrawn. It may be well here to compare the relative merits of what has been denominated the plenum principle, and that of extraction just referred to.

When Mr. Sutton was advocating his method of extracting foul air from ships by the agency of heat, Sir Jacob Ackworth the then Surveyor of the Navy put the question, "Do you know how far you are to draw it out?" The answer was, "Only six inches, for, if I can extract it never so small a distance, the incumbent air will press forward of course, and cause a constant change." From that period to the present, the plan of extraction, and the plenum principle so-called, have each had their own supporters, and good authorities are still divided in opinion on the subject. The safest position would seem to be that circumstances alone must suggest the applicability of the one or the other in any particular case. I think, however, it will be admitted that from the very configuration and structure of a ship, the natural mode of

ingress of pure air is through the central part of the body, while the egress of foul air should be lateral. Now this proposition is not at all incompatible with independent lateral modes of ingress, and central channels of egress, which, although holding a secondary place, are nevertheless quite indispensable. The effect of a spring on the cable, with open ports to the wind, and of an axial air tube in a steamer's funnel, would respectively illustrate such cases. We know also that gases diffuse or commingle with a rapidity which is inversely as the square root of their density. Active egress would therefore favour the law of diffusion *without* or outside the body of the vessel, while by active ingress, or plenum ventilation, the exercise of that law is fostered *within*. Moreover, in the former case, the air would be insensibly renewed, while in the latter, cold draught is usually a concomitant. In a moral point of view, it is quite proverbial, that an attractive or drawing force is more effective than a propulsive one, and the same would appear to be the case in the physical world. Thus, for example, it would be easier to suck or draw up a given quantity of water from a depth of 20 feet, than to impel it to a corresponding height. So also it would be easier to extract 1,000 cubic feet of air from the body of a vessel, than to force the same bulk of air into it. The pressure on the contained air would be diminished in one case, so as to induce the ingress of denser air at every opening, while the pressure though increased in the other, would not only more tardily produce the opposite effect, but favour stagnation in the very localities, that would require the most efficient ventilation.

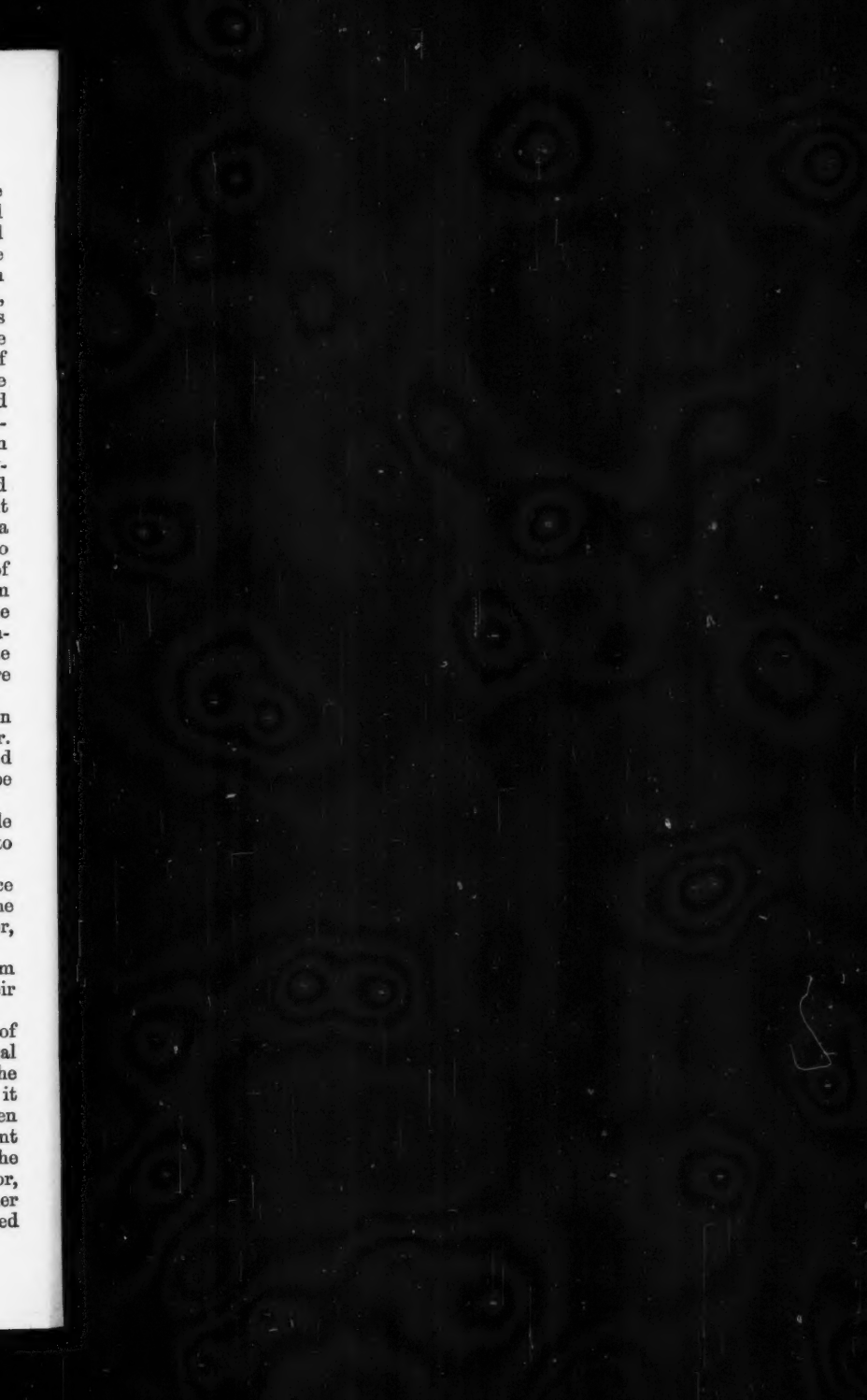
If there is no fallacy in this reasoning, we might conclude that extraction would be preferable to inward propulsion, were we restricted to either. My own feeling, however, is, that no restriction of this kind need exist, and that both may be employed simultaneously when it would be feasible to do so.

The ventilation of circumscribed or inclosed spaces, should be made to imitate mild open air conditions as nearly as possible, and its motto should be "*bonâ fide* perpetual and insensible change."

This is the great desideratum, and I shall now pass on to notice some of the more important systems, proposed or adopted with the view of accomplishing it, commencing with natural ventilation, or, rather the means intended to make it more efficient.

Ventilation by windsails, appears to have been the earliest system in use on board ship, and I am not aware that the precise period of their introduction is known.

They were probably suggested by the observed deflecting power of ordinary sails, more especially when a ship is "on a wind" as nautical men express it. A great volume of air is often sent down through the waist of a ship, from the body of the mainsail, or main trysail, and it is common enough to spread small sheets of canvas, even between decks, to deflect a current of air through a hatch or other convenient opening to ventilate the space below. This principle was known to the ancient Egyptians, from whom the so-called *mulguf*, or wind conductor, has been handed down to the present inhabitants of Cairo, and other neighbouring towns. The mouths of the "mulguf" were so arranged



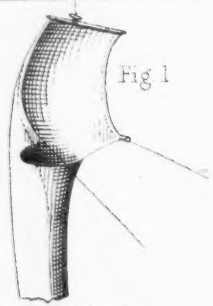


Fig 1

Ordinary Windsail

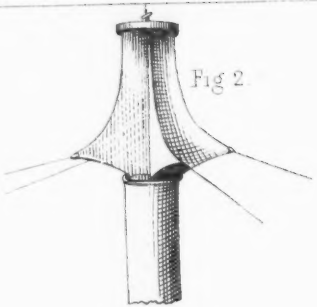


Fig 2

Fixed Form

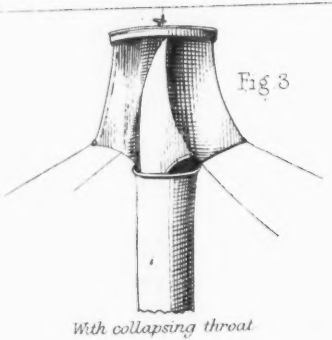


Fig 3

With collapsing throat

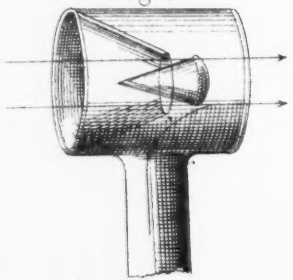


Fig 4

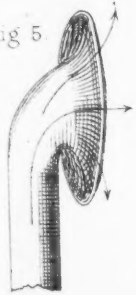


Fig 5

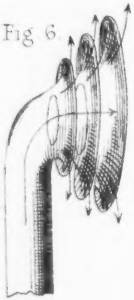


Fig 6

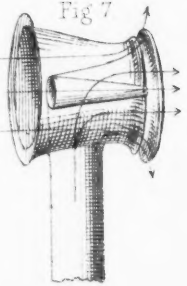


Fig 7

Aspiratory Cowls

J. Jobbins

as to open, at the top of the house in the direction of the prevalent winds.

The windsail in its simplest form consists of a small expansion of canvas spread out to the wind, and connected below with a cylindrical portion, of sufficient length to reach the floor of the space which it is intended to ventilate.

On some unhealthy stations as on the West Coast of Africa, very great length is given to the windsails, with the view of taking the air from a presumably purer stratum than that immediately resting on the water. Figs. 1 and 2, exhibit the two more usual forms of the windsail, viz., the shark's mouth, which requires to be trimmed to the wind; and the fixed form which is so constructed as to receive the wind from whatever direction it may come.

With the high pretensions of this latter, it is scarcely possible that it could be so effective, at any particular time, as the shark's mouth. I have, however, attempted an improvement in it, as is shown in Fig. 3, in which the throat is collapsible, so as to interfere as little as possible with the passage of the air into the shaft. It may be necessary to give the shaft of a windsail, a cunning curvature, when it would otherwise play into the hammocks, and chill the bodies of the sleepers in its vicinity. In some instances, instead of the lower extremity being simply open, it is rounded off, and furnished with numerous perforations, by which means the air is more equably diffused.

The principle of the windsail is also applied in the construction of a receiving cowl and conduit of more rigid material, namely, sheet-iron or copper, which has the advantage of being permanent, and may be used for up, or down draught, as it may be found necessary.

Cowls may be simply *movable*, requiring adjustment by hand, or automatic, needing no interference, being freely versatile on a pivot, and offering the least resistance to the current of air when in the required position.

The known aspiratory effect of ordinary cowls when turned away from the wind, has given rise to numerous modifications of the apparatus, with the object of suiting it to the more efficient discharge of the uptake function alone. In order to comprehend the *rationale* of this function, some little knowledge of the physical properties of common air is necessary. It must be remembered that air is a mobile and elastic fluid, susceptible of very considerable changes in its state and condition by the operation of ordinary and often apparently trifling causes. Its molecules exert an attraction for each other, so that one moving particle would tend to carry other neighbouring particles with it; and those laws by which any disturbance in the equilibrium is restored, exhibit a proportionate power in the reaction. It is thus subject to mechanical movement, friction, stagnation, compression, and rarefaction more or less approaching a vacuum. Now when this latter condition is induced by artificial means, which is only another way of expressing natural means wielded by art, we avail ourselves of the movement, originating in the effort to restore equilibrium, in connection with the mutual attraction of contiguous particles already mentioned.

Figs. 4, 5, 6, and 7, exhibit several forms of uptake cowls. Fig. 4 is apparently a very excellent one, invented by Mr. Boyle a few years ago. It was supplied to Her Majesty's ships "Lord Warden," "Monarch," and others for trial. In the former vessel, it was fitted to one of the air-shafts opening upon the poop, and communicating with the bread-room, shaft-alley, and the limbers. This apparatus consists of a short horizontal tube or cylinder, resting and admitting of rotation upon the upper end of the air-shaft, which opens into it below. But the most ingenious part of the arrangement is an infolded conical curtain, with an axial cone of metal so placed within it, as to allow the air to pass from apex to base, under a certain degree of compression, thus eliciting the air from the shaft, which is carried off at the opposite end of the cylinder, with a force proportionate to that of the wind rushing through it. A small model of this contrivance, exhibited by the inventor, acted in a very satisfactory manner. The shaft was made of glass, so that by gently blowing through the horizontal tube, the rapid ascent of a piece of cotton wool placed loosely on the hand was rendered visible. I may remark, however, that I have seen the same effect with other models constructed for a similar purpose, and must agree with my distinguished colleague Professor Parkes, who is of opinion, that, nothing but a critical series of comparative experiments tested by the anemometer, can enable us to form a just estimate of the relative superiority of one form over another. Fig. 5 acts by simply turning its expanded mouth away from the wind, and Fig. 6 resembles it, but there are several bell mouths placed one within the other. Lastly, in Fig. 7 the aspiratory effect is produced by axial and circumferential currents.

I shall now briefly describe the ventilation of the several decks and compartments of Her Majesty's ship "Lord Warden," as a fair example of an ordinary ironclad. As in too many other cases, the more important features of the ventilation of this ship formed no part of her original design, but were chiefly carried out by Captain Brandreth, R.N., and the dockyard authorities at Malta, subsequently to her arrival on the Mediterranean Station.

Little need be said of the ventilation of the main deck, which is sufficiently insured by the ample size of the numerous hatches, fore and aft in the middle line, and the lateral inlets of the ports, so long as they may safely remain open at sea.

A considerable ascensional force is generated by the heat of the galleys, of which there are two, viz., one for the Officers and one for the ship's company. A large volume of air within the funnel-casings is also constantly moving upwards while under steam. It is important to remember that the plates or sashes of these casings, where they communicate with the decks of ships, usually move on transverse pinions, so as to be capable of taking two oblique positions, but with a difference in the course of the air-currents in each case. When the upper half of the sash is pressed inwards towards the funnel the ascent of the heated air from the deck is secured, whereas an opposite result will follow when it is trimmed in the contrary way.

The excellent scheme of ventilation devised by Arnot for the Field

Lane Ragged Schools has been adopted to some extent in the "Lord Warden," "Royal Oak," and several other ironclads. Thus, a number of stout copper tubes, with curved necks and bell mouths, are distributed at stated intervals along either side of the upper and poop decks. These tubes open flush between the beams of the lower deck over the mess and sleeping places of the men. But, where cabins are built, they extend lower down, and give off lateral branches, which pierce the contiguous bulkheads, so as to supply two or more compartments, either by their free ends or suitable openings made in their sides. To obviate the draught-like current of air naturally resulting from this arrangement, the extremities of the tubes are turned slightly upwards. By this means the air simply overflows into the surrounding space.

Since the arrival of the "Lord Warden" at Malta, ample and well-protected openings were made through the decks with good effect, wherever it was feasible to do so. Two of these ventilate the after part of the ward-room, which was formerly a *cul de sac*, and was frequently very close when the mess servants were employed there. Others, of similar size, bring the engineer's berth and the gun-room into communication with the main deck; these compartments being also ventilated from the upper deck by cowls and air shafts. Nevertheless, it is obvious that, in the arrangements spoken of, one deck must be benefited at the expense of another, which I maintain need never be the case, if the provision of proper channels for the escape of foul air is made in the original design of the ship.

Captain Brandreth, taking advantage of the strong currents of air usually entering the bow-ports on the main deck, placed a large cowl on either side, so as to deflect it downwards to the lower deck, or even to the fore store-room, a locality much requiring ventilation in most ships.

The removal of foul air from the lower deck is assisted by side-shafts or channels running beneath the beams, and opening into the three hollow masts, and into the fore and after funnel-casings, all of which materially favour the up-draught from below.

A single cowl just in front of the foremast, surmounts a tube which descends to the fore store-room, where it divides into two branches to supply the prison cells, which are thus rather better ventilated than the surrounding space.

The carpenter's and gunner's store-rooms receive a good supply of air from two ample cowls on the top-gallant forecastle.

The magazines (fore and after), are ventilated on Captain Jerningham's plan with rotatory fans and tubular down-takes opening upon the floors from beneath; and there can be no doubt that extraction would, in this case, be preferable to the plenum principle. Dust is raised in clouds, and the pressure must be very considerable under existing circumstances. The magazines in most ships are now ventilated in this way, and the system obviously demands a radical change.

Fresh air is conveyed to the bread-room through a valve-door opening in one of the two square air-shafts descending from the poop;

the equivalent valve in the other shaft acting as an outlet for impure air. The starboard shaft, moreover, passes down with the necessary curvature to the limber on the corresponding side of the screw-bed, while the port one terminates simply at the roof of the alley. By throwing back both valves in the bread-room, it will be seen that all communication with the lower parts of the ship will be cut off, and while this is the case, the smell of biscuit imbuing the hot air is often offensively strong at the mouth of the up-take cowl.

The bilge air finds access to the furnaces, and the two large tubes by which the ash-buckets are brought up from the stokehold act most efficiently as ventilators—one usually acting as an uptake, while the other discharges an opposite function.

By an ingenious contrivance, also, the foul air of the stokehold is carried up through a tube in the axis of each funnel, a powerful draught being generated by the surrounding heat. Since this improvement was effected, the temperature of the stokehold under full steam is known to have fallen as many as 40° in certain places.

Finally, by the judicious arrangement of septa or curtains of sheet iron, so as to determine up and down currents on the opposite sides, the ventilation of both engine-room and stokehold has been much improved. I have been thus particular in describing the ordinary means of ship ventilation, that you may be better able to comprehend what a little further exercise of art can do.

Sir Gilbert Blane notices briefly a ventilating appliance, which was fitted to the French frigate "La Nymphe." This consisted of "a "square wooden pipe, of about 9 inches in the side, coming from "between decks, running along the side of the ship, and opening over "the gunwale of the forecastle." The idea appears to have been copied in some of our ships at the time, and we read of the substitution of metal for wooden tubes subsequently. A comparative estimate of its utility may be formed from some further remarks of the same author. Thus, a "better contrivance than this," he says, "has lately been "adopted on board some hospital and prison ships. It consists in an "aperture made in the middle of the deck overhead, 3 feet long by 1½ "wide, from whence a tube ascends, tapering into the open air about "6 feet above the upper deck; and to prevent strong currents of air "from descending, a screen is made to traverse with the wind by means "of a vane, so as to keep the opening to leeward of it."

In the further history of this interesting subject, we have to notice some of the more important schemes or means of artificial ventilation.

During the greater part of the last century the hygienic requirements of the Houses of Lords and Commons seem to have given a considerable impulse, though of a remitting kind, to the whole subject of ventilation, whether applied to public buildings, private dwellings, or ships.

From the ventilation of the House of Commons, and originating with a single individual, the celebrated Dr. Desagulier, we may be said to have derived two of our present leading agencies in ship-ventilation, namely, the extracting power of heat, and the rotatory fan. True, indeed, Mr. Sutton, apparently without any knowledge of Desagulier's previous

application of heat as an extracting force in the case of the House of Commons, conceived and applied his idea of utilizing the heat of the galley in a similar way for the ventilation of ships. Thus, the name of Sutton is more commonly associated with this principle, while Desagulier remains the indefeasible inventor of the rotatory fan. Both systems were strongly advocated by their respective authors at a time that we were fitting out an expedition against the Spaniards, and when the sad deficiency of the ventilation of our ships of war alarmed the Government by its serious effect upon the health of the troops embarked at Spithead.

To the labours of a philosopher, Dr. Desagulier, and a brewer, Mr. Samuel Sutton, we must add those of a divine, the Rev. Dr. Hales, F.R.S., who brought into the field of competition a large double-acting apparatus, on the bellows principle. It consisted of two elongated boxes having valvular openings and a movable diaphragm within; to this he gave the appellation of the "ship's lungs," extravagantly overrating its effects. As Mr. Tomlinson has given a very circumstantial and humourous account of this whole story, I must refer you to his excellent little work on "Warming and Ventilation" for particulars, which my limited time will not permit me to introduce here.

In reference to the ventilation of hospital and prison ships, I have now to propose and describe to you, a system which I am quite sure you will recognise to be one of great importance, not only to Government vessels, but also to our Merchant Marine in general.

Those who are acquainted with even the rudiments of the structure of wooden ships will readily perceive, when their attention is directed to the subject, what a large amount of air space, available for the purpose of ventilation is included between the outer and inner planking and the timbers of the hull. Here, as by a kind of necessity associated with the nature of the materials of which the fabric is built, a great auxiliary to the general ventilation has always been at hand, but, strange to say, never, up to a comparatively recent period, has it been turned to any satisfactory account. When Dr. Reed employed the principle of extraction (by means of a large central shaft furnished with a rotatory fan) to ventilate the ships of the Niger Expedition, downward currents were established in the openings between the timbers. At a subsequent period, the late Dr. Edmonds, R.N., obtained the same result by the agency of heat. Now the natural ascensional tendency of the air in the openings to which I refer, is at variance with both these systems, and is evidenced by the escape of bilge air when their operation is arrested altogether, or is even much enfeebled.

As far as my own suggestions are concerned, the simple statement of the case is this, that under existing circumstances, while much valuable space is lost instead of turning it to good account, ascending currents of impure air are constantly rolling into the cabins of the officers, and the sleeping places of the men, to mix with air, already contaminated with the products of respiration, combustion, &c., and for the escape of which, no rational provision is made. I hope this statement is not overdrawn. I can only say that it is quite in accord-

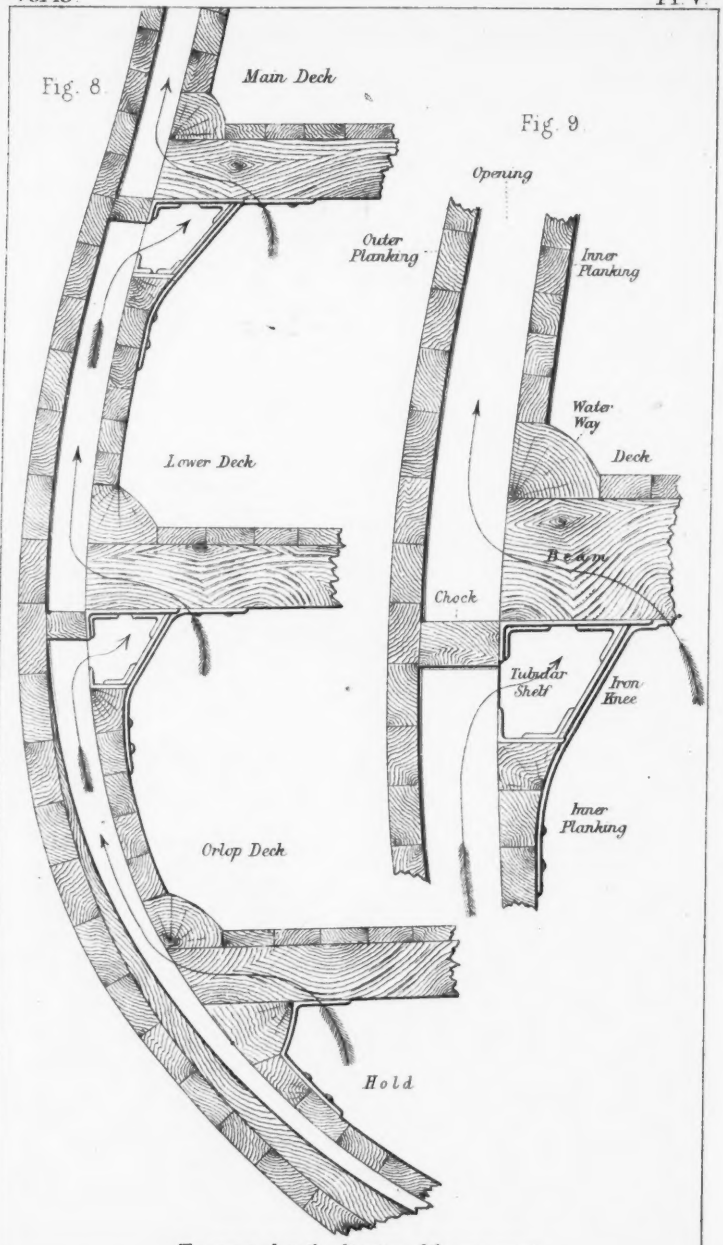
ance with my own experience, and, in any case, it will serve to point out to us the evils requiring correction, and the obstacles to natural ventilation which should be amenable to art.

I have, elsewhere,* laid some stress on the importance of establishing a free and perfect circulation of air, at least, in the vertical direction, between the outer and inner planking of the sides of wooden ships, which might be readily done in the several ways there pointed out, though, of course, this would be more satisfactorily accomplished during the construction of a vessel, than at any subsequently period. Thus, every difficulty might be met at its first appearance, and suitable provision could be made for future contingencies in carrying out the object in view.

Should the further suggestions I have to make on the present occasion be without objection as to their practical application,—and I have every reason to believe them to be so,—an experiment might be made, which has certainly never been fairly tried before.

Seeing the numerous interruptions of the channels between the timbers, that must happen in a Man-of-War by the port-sills, chocks, and fillings for various purposes, I feel quite sure that the ventilation of each deck must be regarded as a separate question. It would also be desirable to encroach as little as possible on the existing space requiring ventilation, by any proposed plan. It therefore occurred to me, that, as iron box-keels and keelsons had already been introduced to answer the purpose of parts requiring great strength, as an essential condition, a hollow iron or box shelf-piece might be substituted for the ordinary one of wood. Thus, without making any noticeable alteration in the normal appearance of the ship's side, either within or without, the great desideratum of a continuous air-tube just below the beam ends, and holding communication with all the openings immediately below it, would be obtained. By inserting chocks of wood in the several openings, at the upper level of each shelf-piece tube, the ventilation, or the removal of the heated air of each deck would be provided for, through the intercostal channels of the next deck above. Moreover, by this arrangement, it would be quite impossible for the foul air of one deck to find its way into another. Indeed, if at any time the up-draught effect were reversed, only pure external air could return to the particular deck concerned, irrespective of those above or below it. (See Figs. 8 and 9.) Thus, then, commencing below the orlop deck, what may be termed the bilge air takes the direction of the arrow winding over the first shelf-piece (which need not be tubular) into the openings above it. The first series of chocks not only arrest the further ascent of the foul air but direct it into the tubular shelf-piece of the lower deck. From the orlop deck the current passes over the shelf-piece of the lower deck to the openings above it, and finally, into the hollow shelf-piece of the main deck, below the second series of chocks. In a similar way the vitiated air is conducted upwards from the lower and main decks. Thus, in an ordinary frigate that might be fitted up as an hospital ship, the air from the bilge space and the three

* Appendix No. 4. "Health of the Navy for 1867."



The arrows shew the direction of the air currents.

J. Jobbins

succeeding decks would be carried off by eight longitudinal air-shafts, engaging with the intercostal openings, an area equivalent to about one-sixth of that of the solid measurement of the ship's walls or shell. The advantages that may be fairly expected to accrue from the adoption of this scheme may be stated as follows:—

1. The admixture of bilge-air with that of the orlop deck is rendered nearly impossible by its continual removal through the shelf-tube of the lower deck, leaving but little scope for the operation of the law of diffusion.

2. The bilge-air being carried away by the shelf-tube of the lower deck is effectually cut off from intrusion upon any other deck.

3. The air ascending from each of the succeeding decks is separately eliminated, without any possibility of commingling by reversal of the currents or otherwise.

4. As a corollary, the pouring forth of foul air from the lower parts of the ship into the living and sleeping places of the Officers and men would be entirely prevented.

5. The extracting power would be exerted upon the mass of air just beneath, or between the beams, where the products of respiration and other impurities naturally accumulate, while its place would be taken up by purer air.

6. No stagnation of air could happen in any part of the shell, so as to favour the tenacity of infection; under which circumstances, also, fumigation would be always more effective than it is usually found to be.

In the application of this principle to iron ships, any difficulties that may prevent themselves would certainly not be insuperable to the practical constructor in whose hands, even the most stubborn materials become plastic, when his purpose is once inspired to carry out an object in view.

In the case of iron ships as in those of wood, the extensive surface afforded by the walls of the vessel would suggest that a similar advantage might be taken of it for the more efficient ventilation of the hull.

Whatever may be the material of which a ship is built, no locality would appear to be so well suited for the removal of vitiated air as the angle beneath each deck, just where it joins the ship's side. This fact simplifies our idea of ship ventilation very much, for if there were 50 decks, vitiated air would take up the same position in all. In iron ships, however, the office of iron knees and shelf-pieces is superseded by the buttress-like ends of the beams, which are secured by rivets to the frames, so that the difficulty of running a longitudinal air-tube in the locality referred to, meets us at the outset. But it must be remembered that, in the ordinary mode of forging and forming the buttress of the beams, an angular space is left favourable for the transmission of an air-tube, to which a corresponding form might be given. This tube should receive conduits from the deck below, while in the immediate vicinity should be planned the openings of similar conduits, leading to the air-shaft of the deck above. A second difficulty here presents itself, namely the perforation of stringer plates, the integrity of which

is regarded as of so much importance to the longitudinal strength of the ship. A little ingenuity of construction, however, would, doubtless, effect the purpose in question, with no material sacrifice of strength.

The system I have just detailed together with the adoption of the deck air-channels of Dr. Edmonds, and the intelligent use of all other available means would be well suited for hospital or prison ships. It will also be obvious that whether the air-shafts are made to communicate with the funnel-casing or the hollow masts, or furnished with extracting fans, the principle must be in effect the same.

Should vessels of the Monitor class be multipled in our Navy, the question of ventilation as applied to the circumstances of closed ports and hatches, necessitated either in action or in heavy weather, must become one of the greatest importance. To this class belong such vessels as Her Majesty's ships "Glatton" and "Devastation," a good general account of the ventilation of which, on the plenum principle, is given by a writer in the April number of "Naval Science" for last year. Of the former vessel it is stated that "a shaft 5 feet 6 inches "by 6 feet 4 inches, is sent from the top of the upper deck to the level of "the main deck just abaft the smoke stack, and is continued above "the upper deck to a height of 12 feet, the walls being rifle proof, and "furnished with doors leading to the upper and first decks, both of "which must, however, always be closed in rough weather.

"At the bottom of the shaft are four fans, connected with two "transverse tubes, the upper of which is 16 inches by 12 inches, and "the lower 16 inches square. The fans, propelled by the engine, "collect fresh air from the shaft and send it into the tubes, from "which latter it is conveyed by means of pipes to every cabin and "compartment of the ship, fore and aft, by goose-necked funnel ends, "that open a few inches from the floor of the deck, and are each "supplied with a screw valve. There are in the 'Glatton' 133 of "these outlets.

"The principle adopted in the 'Devastation,'" says this writer, "is pretty much the same, but the arrangements are different in "many respects. Thus, there are in this ship three shafts and five "fans. One shaft is fixed just abaft the mainmast, and has two fans. "The other shafts are placed just abaft the foremast, and are close to "each other, but distinct, the smaller enclosing one, and the larger, "two, fans. All these fans are provided with distinct sets of engines, "and work independently; but it is an important arrangement, and "one that contrasts favourably with the system adopted in the "'Glatton,' that if one or two shafts are blocked, or otherwise ren-"dered useless, the third can, by intercommunication, supply air to "all the compartments." It only now remains to be stated that, as no special provision is made for the removal of vitiated air in either of the ships referred to, after its more or less complete diffusion, it must find its escape as best it may. It will be seen that the constructors have been at much pains to isolate the function of the different fans, and provide against the contingency of injury to a part interrupting the action of the whole. It is, however, quite a question whether a

very effective ventilation could not be maintained, even without the rotatory fans, if only a fair channel of escape could be made for the impure and expanded air. The whole subject is, indeed, so new, and involving, as it does, considerations upon which good authorities are yet at issue, that I would approach with caution any criticism as to the detail of the system carried out in the ventilation of our low freeboard ships. What I have further to say, therefore, must deal with general principles.

In devising the arrangement of tubes for the supply of air on the plenum principle by means of propulsion, at least five essential particulars must be taken into account:—

1. The manner in which the external air is conveyed to the axis of the fans.
2. The size of the original shaft in relation to the required supply.
3. The number of divisions and subdivisions of that shaft.
4. The angle at which these divisions and subdivisions are given off.
5. The calibre of these latter as compared with that of the primary trunk.

The full consideration of these several points would take up more time than I have at my disposal at present, but they would form good subject matter for discussion. In conclusion, therefore, I shall only repeat my conviction, that the system of extraction would be found to be much more satisfactory than the plenum principle, as applied to the ventilation of our low freeboard ships.

I WILL now, with your permission, call attention to these diagrams. In this one, representing an athwart ship vertical section of the "Hercules," we have the double bottom laid open, the ventilation of which is a desideratum. This is the "Warrior," the first of our iron vessels made with large perforations in the frames to reduce the weight, a purpose which is carried out in a much more satisfactory way by the bracket-plate system introduced by Mr. Reed. Here we have a mixture of the longitudinal and transverse systems of framing, the frames and longitudinals dividing the bottom into compartments. Some use may, perhaps, be made of the wing passages for the purpose of ventilation, but in what way this may be done, has yet to be considered. A very considerable space may be used for that purpose. The "Lord Warden" is a wood-built ironclad, so called. Four and a half-inch plate was considered to be quite sufficient to repel shell at the time the "Warrior" was built, but as improvements in gunnery went on, additions to the thickness of the plate were found necessary, and an inch and a half plate was placed between the outer planking and the timbers in the "Lord Warden." This vessel was built solid, and is literally three times as strong as a ship with channels between the timbers. But still several of these were kept open and in communication with the bilge. This, a radical defect, the oldest and most persistent evil connected with wooden ships, actually exists in the "Lord Warden." Though in many instances the channels alluded to are preserved for the purpose of ventilating the walls of the vessel, they can only do so by pouring mephitic air into the officers' cabins, and into the sleeping space of the men.

In tracing out the different systems of ventilation already followed, I shall direct your attention to these plans on the wall. The upper plan represents the system of Desagulier. The rotatory wheel originally placed by him over the House of Commons in 1736 was rather defective. In the first place, its axis was perfectly central; it had about twelve radiating blades, and the discharge pipe gradually contracted instead of expanding in its course. Now there is great reason to believe that as air tubes are distributed through different parts of a vessel instead of becoming smaller and smaller they should expand in a certain ratio; extraction is also more satisfactorily

effected when the tubes gradually expand, as they diverge from the fan to the body of the vessel. *Here* (pointing) in the modern fan, we have several improvements introduced, by which, with a very much smaller machine, a relatively greater effect is produced, the arms of the fan are less numerous, and the axis is eccentric. *This* is a section seen end on, showing the position of the axis and the hollowing out of the fan blades on each side, near their attachment. The centrifugal force of the fan drives the air with very considerable velocity in the direction of the discharge pipe, and at the same time an in-going current takes place at the axis. It is absolutely necessary that in plenum ventilation this in-going current should be cut off from all communication with the body of the vessel, and pass down from the open air through a tube having direct communication therewith. Subsequently to this, other schemes of ventilation were proposed, viz., Mr. Sutton's and Dr. Hale's, which I have already mentioned.

In the early part of the present century an ingenious contrivance for the ventilation of ships was invented by Mr. Perkins. You will find an excellent account of it in a little work by Dr. Finlayson, R.N., upon the baneful effects of too frequently washing ships' decks, in which a plate of this ventilator is inserted as a frontispiece. You will perceive a tank on each side half filled with water, and communicating with each other across the ship by means of a horizontal pipe. With the upper part of these tanks other tubes are connected, viz., a discharge pipe, and one leading from the bilge, so that as the ship rolls from side to side by the pumping power produced, the bilge air is drawn up into one tank while it is expelled from the other. This principle has lately been carried out in a more satisfactory way by an American invention, under the name of "Thiers' Automatic Bilge Pump and Foghorn." The system has been adopted in the "Thetis," and in several other ships, and a commission appointed to report upon it gave a favourable account of its operation. The principle is the same as that of Perkins, but with this difference, that Perkins seems to have taken advantage of the pitch as well as the roll. In "Thiers'" plan, the motion is purely lateral, the rolling being taken into consideration. Mr. Perkins, on the other hand, placed his tanks obliquely, so that a partial effect might attend the pitch as well as the roll. In Thiers' invention, a tube leads down to the bilge from the upper part of a cylinder placed on each side of the ship, and containing a portion of mercury, both cylinders being connected by a transverse tube. As the ship rolls to port, the mercury ejects the water accumulated on the corresponding cylinder, and conversely when it rolls to starboard the mercury will run along the connecting tube to the other side, and eject the water from the starboard cylinder. By a similar contrivance the bilge air is expelled, water being the moving piston, so to speak.

I have on the table several forms of cowls. The great point giving effect to *this* simple cowl (Fig. 5) is, that the expansion of the mouth is very considerable in proportion to the volume of the tube, seeing that one atom of air in motion will attract other atoms in its vicinity. *This* cowl (Fig. 6) was planned by myself on that principle by invaginating, as it were, a number of conical pieces or lips in this way, and it acts very effectively. In *this* instance (Fig. 7) the outer cylinder confines a portion of the air passing between it and the bell-like expansion af the air shaft, through the back of which another conical portion passes. The aspiratory effect of the circumferential current is such, that the passing air, by its homogeneous cohesion, attracts the air around the circumference of the shaft-mouth, and by the same law, provision is made for the central part of the current to be acted upon.

Mr. Boyle's cowl (Fig. 4) I have already given a description of. There seems much mechanism in it. I have here a model of the scheme proposed in diagrams 8 and 9. Here we have a lower-deck cabin with glass slides, so that you may see the effect of a taper burning in it, and over the shelf-piece of this cabin openings exist communicating with the channels between the timbers. *This* would be an open space, corresponding with the deck above; *here* are the ends of the beams cut off; here we have the tubular shelf-piece, and *here* a number of chocks which cut off these channels from all communication with the deck above. By lighting the taper, and placing it inside, we see the ill-effects of a circumscribed space. The light is now dim, owing to the foul air, but by putting an uptake cowl in communication with the tubular shelf, and imitating the motion of the wind by a pair

of bellows, we brighten the light. If you were to substitute a human being for this light, which would be perhaps a very fair thing, because one individual is equivalent to one candle, you will see that he could not live long under such circumstances.

Mr. Edwin Chadwick, C.B.: I will preface the questions which I am going to ask by a short statement. There was in Paris a gentleman who, of all other men of science, handled the air, if I may so speak, more boldly and successfully than anybody else I have met with; and he contracted to remove vitiated air from hospitals, to introduce fresh air at a given rate of temperature, and to remove it from any part at a given rate of speed. He did whatever was required of him on the principle of aspiration. I would not rely on my own observation, but I would greatly rely on the observation of General Morin, who has thoroughly studied this question. I was informed that in consequence of the great losses that had occurred in the transport of horses to the Crimea, they applied to the Professor, Leon Duvoir Le Blanc, who did this work for hospitals and other edifices, to ventilate ships; and I was told that he had accomplished the same result that was clearly accomplished in the hospitals—introducing air at a given warmth, and removing it at a given speed,—and that it was done with perfect success as to the horses. One cannot follow a lecture like this without plans in hand and a little consideration, but I should like to know from the lecturer what results he conceives are clearly attainable by the present state of knowledge or practice upon this question. Is it such that we can now do what was said to have been done, and indeed actually was done, with respect to the horses, namely, introduce air into any room, and at any temperature you liked, and remove it at a given speed, such as you would prescribe. I should like to know from him if we have attained the same results, and whether we can send down air at a given temperature into the lower parts of the ship, or any part where the ship may be crowded, and remove it at a given speed?

Dr. Macdonald: It can be done if only an order be given to do it. It may be expensive, no doubt. Instead of injecting air into a vessel, I should use extraction in preference, and certainly the amount of horse-power required to throw off, or to extract a certain number of cubic feet per minute, is a matter of simple calculation. You take, first of all, the effective velocity of the fan, which would be, perhaps, three-fourths of the entire velocity of the extremities of the fan. That, multiplied by the sectional area of the opening through which the air passes, will give you the number of cubic feet per minute. Then you have to take the other questions connected with it. Say the effective velocity is 70 feet per minute, then what would be the number of feet through which a heavy body must fall in order to attain the velocity of 70 feet. For 70 feet it comes to about 76·5. You have to multiply this again by the number of pounds. You can reduce the number of cubic feet of air into pounds by dividing by 13, because 13 cubic feet of air is equivalent to a pound. Then the whole result must be divided by 33,000, which is the number of pounds a horse will lift one foot per minute. That calculation could be easily done. Then, of course, if you wish to get warm air in, you must have combustion to effect that, and pass the air over the heating surface.

Mr. Chadwick: This result, it is to be borne in mind, was obtained in Paris, by the principle which General Morin approved, by the principle of suction direct from the chief source of vitiation, and not by fans, simply by means of heating the air of the ascending vitiated flues, at the exit of the tubes, and regulating that heat with skill. That, certainly, was done in the hospital La Riboisière, on a contract to change the air of the hospital, 56 cubic metres per bed, I think, for two sous a day, to keep it at 60°, to change it every hour, which is a rate of warming that we do not attain, with our cheap coal, in England. The Society of Arts have sent to the French naval department for particulars as to what was done with the horses. I may say, about the care of the sister service there, that, although they thought of ventilation, in consequence of the great loss of horses, it did not appear to have occurred to them to be necessary on account of the loss of men.

Dr. de Chaumont: I am inclined to think the question of Mr. Chadwick, which has been answered by Dr. Macdonald, is one entirely of expense, and, whether we take up the question of the ventilation of ships, barracks, or hospitals, there can be no doubt the air can be changed sufficiently often, and be warmed sufficiently, if the expense is sanctioned for the purpose. Hitherto, this has been the great

difficulty, and in no case, either in ships, barracks, or hospitals, has the air been changed in anything like the degree necessary to keep up perfect health, either for men or animals. With regard to the method of applying the principles of ventilation, I am quite of the same opinion as those who have already spoken, that extraction is very much superior to propulsion, in every case, and in the case of the Hospital La Riboisière in France, it was shown that the artificial means of supplying air supplied only 15 per cent. of the whole air, and the remaining 85 was supplied by the natural methods of extraction, which are applicable in almost every case. There are two or three points which we must bear in mind. In paying a visit to the "Devastation," with Dr. Macdonald, I saw the method of ventilating the Officers' cabins, and the method was, that a tube was carried along the upper part of the cabin, with holes perforated in the sides of the tube. The number of holes made was only equal to the sectional area of the tube. This was perfectly insufficient to supply the proper quantity of air in the cabin, because the loss in dividing an air tube into a number of small openings is in the ratio of the square root of the opening. It would be quite easy, therefore, to calculate the quantity of space that would have to be given. If you divide your air tubes into four parts, you lose one half of your available air-space by this process; therefore, whenever a division takes place, there must be a proportionate expansion of the tube. This is a point continually lost sight of, though insisted upon by all the more recent writers on the subject. Then, there is another point that I think has not received proper attention, and that is the very serious effect of angles in tubes. I do not know any work where anything like a formula is laid down on this subject, but, taking a glance at the different diagrams, it seems quite evident that, where you have, in so many cases, a right angle, the air passing down or up must suffer an immense amount of impact on coming to that right angle; that at least one half of it must tend to come to a standstill, and there must be a proportionate loss. It struck me, one might deal with this according to the laws of hydrodynamics, and calculate out the loss that would be found in something the same ratio as the resistance of bodies in water. I think the formula would be met pretty well by a fraction, the numerator of which would be unity and the denominator would be one, plus the square of the sine of the angle the tube would make with the original axis. Where we have a right angle, the amount would be reduced one half, and this table would show the proportionate loss at successive angles.* (Dr. MACDONALD: The table referred to by Dr. de Chaumont, representing the formula, was left behind, by accident, but that certainly is an approximation to the truth, if not the thing itself.) This point ought to be taken into consideration that, wher ever we have an angle, we must use a formula like this, and where we have a subsequent angle, the amount will be the product of the two available results. And if, again, we are to proceed to minor tubes, in addition to these angles, we must allow very much more for the loss, unless we expand the tubes proportionately. These points are well worthy of consideration, as forming some of the most essential points on the subject of ventilation.

Dr. MACDONALD: I can illustrate the bad effect of angles by a very simple diagram. Suppose the tube is bent at an angle of 90°, the air, though compressible, would follow the ordinary laws of light and heat in its motion, thus passing down at the rate of 1,000 feet a minute. The deflection back again would be very con-

---

* Assuming the available air to be represented by VA, when V is the velocity and A the sectional area, the coefficient of friction due to angles may be taken as $\frac{1}{1 + \sin^2\theta}$, so that the net available delivery of air will be: $VA \cdot \frac{1}{1 + \sin^2\theta}$, which will equal VA × 1 when θ is 0°. At other angles it will be as follows:—

$\theta = 15°$	$\frac{1}{1 + \sin^2\theta}$	$= 0.937$
$= 45°$	„	$= 0.667$
$= 70°$	„	$= 0.531$
$= 90°$	„	$= 0.500$

So that a right angle reduces the amount to *one-half*.

siderable in that case (an angle of 90°). A certain portion of air, however, would pass on. The angle of deflection is equal to the angle of incidence; that law would be carried out very perfectly, and the air in the tube would suffer a remarkable series of deflections thus. There must be a very great loss in this way—a loss which is calculated to be equivalent to one half—so that we should have only 500 feet passing out instead of 1,000.

Now, we will draw a diagram in which the tubes gradually increase in size from their origin. The course of the air is direct, in some instances, after the first deflection. There is, comparatively, little loss in the transit of air by this expansion, which permits of the delivery of the air without the enormous friction which must take place by the continued contraction of the tubes. I have now only to return you my thanks for the kind attention you have paid to me.

Mr. CHADWICK: I would commend to the attention of the naval hygiènists a very good book, published by M. de Fonssagrives, the professor of Hygiène at Montpellier, and for a long time a Naval Surgeon. It certainly contains a great deal of fact, worthy of attention, on this, amongst other subjects. Amongst other things, I may mention one that as a statist I was very much interested in. He shows the degree of mortality amongst different classes of seamen—those down below and those higher up in the ship—that the degree of mortality ranges with the degree of vitiated air to which they are habitually exposed.

The CHAIRMAN: We must all admit that this subject is an exceedingly interesting one, and hitherto, I think, it has not received the attention which its importance demands. I say, as a sailor of experience and knowledge, there is no question that the system of ventilation in our ships has been of the rudest kind, not at all corresponding with the progress of science in the present day. I have listened, with great interest, to the observations which have been made by the lecturer, as well as to the very interesting statements of Mr. Chadwick and others. For my own part, I believe the true principle of ventilating ships, as well as buildings, is the principle of extraction, and you will really do very little good, unless you thoroughly and completely adopt the system of getting rid of the foul air, by artificial means, if you please, and leaving the supply of pure and fresh air to natural means, which will be easily accomplished. I think the meeting will join with me in expressing our thanks to Dr. Macdonald, for the very interesting lecture he has given us.

PROPOSED FORMATION OF A BATTALION FOR THE ATTACK.*

By Major T. S. Bigge, 5th Fusiliers.

Preliminary Remarks.

The following propositions for a Battalion Attack Formation were submitted by me to His Excellency the Commander-in-Chief in India in June 1873.

I have thought it advisable to keep half a battalion in single rank in reserve, not so much for the purpose of actually reinforcing the companies of the half-battalion engaged, as to have a force in hand for operations on the flank of the line of attack, or perhaps to supply the place of a company, or companies which might have met with serious losses.

My object in introducing the Double-Company Skirmish Formation is merely to ensure a more rapid extension of the advocated four-company-attacks from line or column, and yet to retain four in reserve: besides, in this formation, the outer reserve companies would be much nearer for a rapid prolongation on the flanks of the line of attack.

I have not deemed it necessary to give the Captains' executive words of command, which are obviously most simple. The movement of companies to the front or flanks, would be carried out either from line or column, by fours or columns of sections.

My apology, if such is needed, for publishing this paper, is simply to invite discussion on a matter which is, I submit, the most important military question of the day, viz.: "The Tactical Formation to be in future adopted by our Infantry."

Instructions.

The formation of a battalion to be invariably in half-battalions in line, or in line of half-battalion double-company or single columns, with proper intervals when space permits.

On approaching under fire, the word of command will be as follows:—

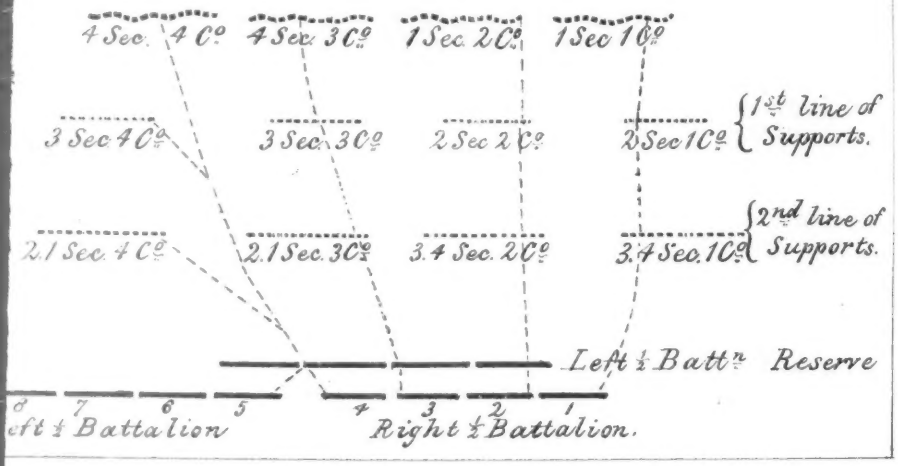
1st. "*The right* (or *left*) *half-battalion will skirmish by companies,* "*extending from*—(any named) *company, the left* (or *right*) *half-*"*battalion in reserve:*" or,

2nd. "*The battalion will skirmish by double-companies, extending* "*from*—(any named) *double-company, finding their own reserves.*"

* It may interest the members of the R.U.S. Institution to learn that this formation has been extensively and frequently practised during the present drill-season, by the Bareilly brigade, under the command of Brigadier-General Olpherts, V.C., C.B., Commanding Rohilcund District, it is thought with most satisfactory results. —T.S.B.

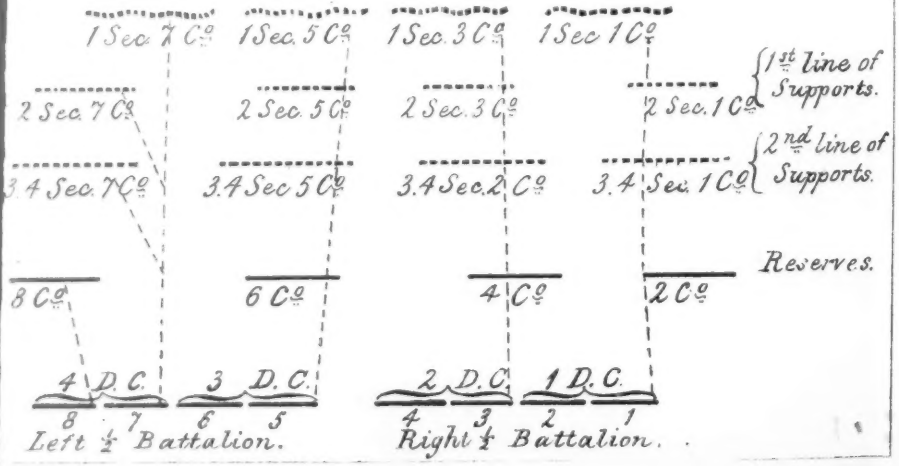
No. 1.] FROM LINE.

The Right Half Battalion will skirmish by Companies, extending from No. 2 Company. The Left Half Battalion in Reserve.


4 Sec. 4 Co
4 Sec. 3 Co
1 Sec. 2 Co
1 Sec 1 Co
3 Sec 4 Co
3 Sec. 3 Co
2 Sec 2 Co
2 Sec 1 Co
1st line of Supports.
2.1 Sec. 4 Co
2.1 Sec. 3 Co
3.4 Sec. 2 Co
3.4 Sec. 1 Co
2nd line of Supports.
Left ½ Battn Reserve
8 7 6 5 4 3 2 1
Left ½ Battalion
Right ½ Battalion.

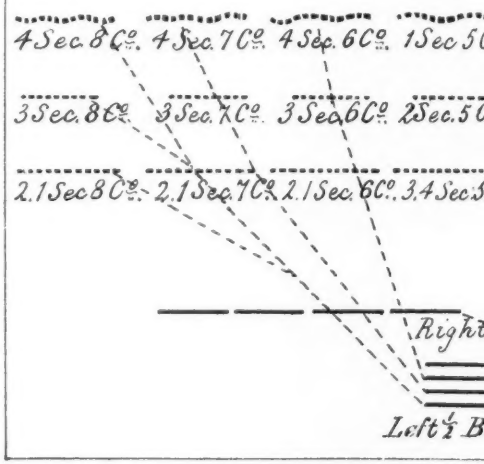
No. 2.] FROM LINE.

The Battalion will skirmish by Double Companies, extending from No. 3 Double Company, finding their own Reserves.



No. 3.] FROM LINE OF HALF BATTA

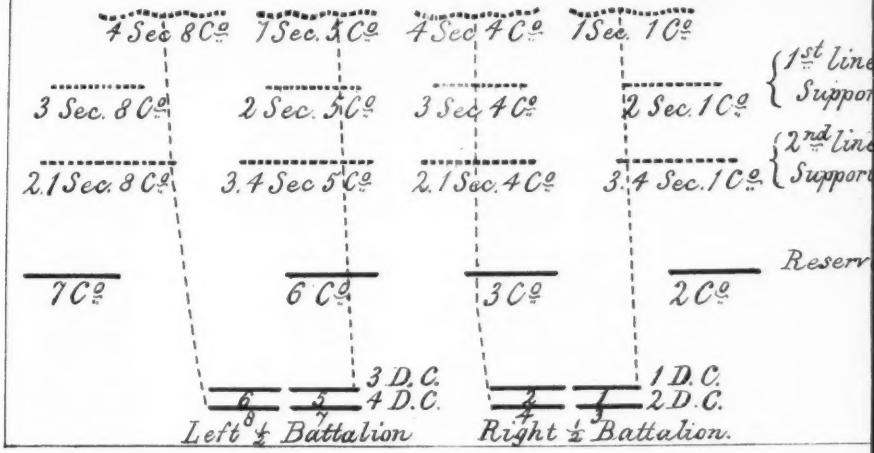
The Left Half Battalion will skirmish by Com
Remainder prolong to the left. Rig



Harrison & Sons Lith. St M

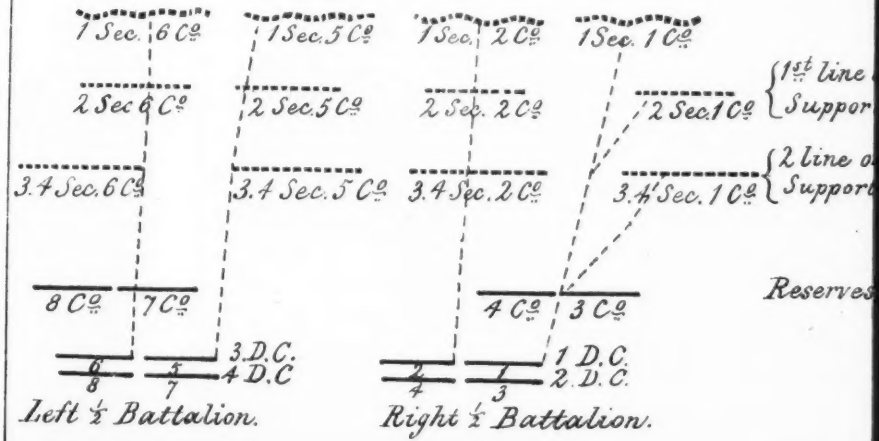
No. 4.] FROM LINE OF HALF BATTALION DOUBLE COMPANY COLUMNS.

The Battalion will skirmish by Double Companies, extending from No. 1 Double Company, finding their own Reserves. Prolong to the left.



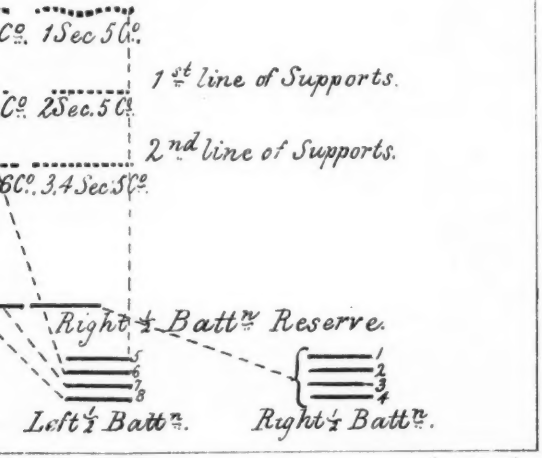
No. 5.] FROM LINE OF HALF BATTALION DOUBLE COMPANY COLUMNS.

Nos. 1 and 3 Double Companies skirmish by Companies, extending from No 3 Double Company. Remainder in Reserve.



HALF BATTALION QUARTER COLUMNS.

irmish by Companies, extending from No. 5 Company the left. Right Half Battalion in Reserve.



Sons Lith. St. Martins Lane, W.C.

(3700.4/54.1843)

On this order for the half-battalion or battalion to skirmish, extending from any named company or double-company, it is to be understood that the Captains are never to extend more than one section, their second sections to be in loose order in first line of supports, their third and fourth sections in loose order in second line of supports.

The sections on the flanks of the supporting lines to be in rear of the flanks of the skirmishing line, so as to be in readiness to meet the enemy's attempt to turn our flank, or move by the shortest line to turn his.

When a section is rushed from the first line of supports to reinforce its skirmishers, another section, or the two remaining sections, must be rushed from the second line of supports of the same company, to take its place.

The distances between skirmishers and their lines of supports to be, of course, dependent upon the nature of the ground. One company must be always named "Company of Direction."

On receiving either of the above orders, the named company or double-company of formation will at once extend one section—its second section in first line of supports, its third and fourth sections in second line of supports. When double-companies skirmish finding their own reserve, one company of each double-company will remain in line, as a third line of supports or reserve. The other companies or double-companies ordered to skirmish, either from line or column, move to their proper positions on the flanks of the company or double company of formation in fours or sections, and then take up the extension as above directed.

Captains must invariably use their own discretion in extending as skirmishers in the first instance, any number of men *short* of *one* section; for instances may happen, such as in a very open country, &c., where three or four marksmen per company acting as scouts would answer every purpose, and maintain properly the skirmishing line when first approaching the enemy.

It is evident that the outer sections of the first line of supports can be used for an immediate *extension* on the flanks of the line of attack, if necessary.

Advantages Claimed.

1st. That by this system all intermixture of the different companies of a battalion is, as much as possible, avoided; for by extending only one section at the head of each company attack, and holding back three more in two lines of support, it is evident that three reinforcements can be effected by each company on the front of a single extended section, and losses must be most severe that could call for more, before the enemy's position was rushed.

2nd. That the captains of companies enjoy a more interested and responsible position; for by this system they will have the immediate direction of their company attack on a comparatively narrow front and deep formation well under their observation and control; and directly the head of their company attack touches cover, they can immediately

reinforce in great strength and most rapidly, on their own responsibility.

3rd. That if it is necessary to prolong the line of an attack already in progress, the company or companies sent to extend it, would go into the fight with their support all ready.

4th. That the soldiers' minds will, by this system, be more accustomed to reflect upon modern tactical requirements, for each company would carry in its own organization that which formerly was only supplied by the battalion, viz., the line of skirmishers and its successive supports, the last line of which might be almost looked upon as a reserve.

5th. That this system can be made to comprise, as far as practicable or advisable, the old cohesive formation of our present line, covered by skirmishers, by simply keeping the three supporting sections per company in loose order in first line of supports, which can be immediately resolved, should a very heavy fire render it necessary, into the advocated new system of attack, by dropping two sections during the advance into a second line of supports.

6th. That the individual improved intelligence of the soldier will, by this system, be more under the control and in better subordination to the direction of those Officers he best knows; and those Officers in turn more amenable to the direction of the battalion or half-battalion commanders; for the narrow front of each company attack and its comparatively deep formation, brings the reserve of each tactical unit nearer the personal superintendence of the chief commander; and orders, in consequence, will be more easily transmitted to the front from the rear, or *vice versâ*, passing through the Officers in charge of the three lines of attack of each company.

7th. That the fire of the men, after reinforcement, will be more easily controlled by this system, which especially provides against intermixture of different companies—Captains, subalterns, and section commanders, having always their own men under their guidance and supervision.

8th. That by this system a battalion covers exactly the same amount of ground as was occupied by our old two-deep line, if it is considered to be necessary; for taking the battalion at eight companies of 80 men each, the two-deep line occupied about 256 paces. By this system the four sections extended in the first instance at the heads of the four company attacks, at three paces between the men (six paces between files) occupy 228 paces, and the three intervals of 10 paces each between the heads of the company attacks, 30 paces more, viz., 258 paces in all; but this essential difference, viz., that our old two-deep line has nothing behind it, whereas the advocated formation has two lines of supports and one of reserve, which can be immediately thrown into the fight at such point of the line of attack where cover is available, other portions being but slightly occupied and refused.

9th. That the supports, being in small handy bodies under their accustomed section commanders, will be enabled, in many instances, to find available cover close to the skirmish line, and consequently nearer at hand to reinforce, directly an increase of force is desirable.

10th. That this system advocates a strong company well under its own Captain's command as the tactical unit—not the battalion or half-battalion; and it is strictly based upon the principles contained in our present "Field Exercise."

Concluding Remarks.

Some are of opinion that a line can be brought up under present breech-loading fire, by moving double-companies two deep at the rush from cover to cover; but I cannot help thinking that a radical change in our drill is necessary, and that any leaning towards our old line is only postponing the adoption of what we must inevitably come to, viz.:—

"The training of the individual soldier to have more confidence in "loose single lines and isolated positions than he has hitherto been "taught to entertain."

I, with diffidence, submit that we cannot have a better proof of this than in viewing the action of a line of our skirmishers when threatened by cavalry; the men, according to their present training, utterly disregarding the fact that they have in their hands a weapon which shoots six or eight times a minute, and with which they have been accustomed to hit a volley-practice target at 400 yards almost every shot, such target not being the twentieth of the size of a squadron of cavalry, rush into rallying squares, which prevents the greater part of them taking aim or firing at all, and delays their giving fire-resistance at that moment when it is most necessary they should do so, viz., when the cavalry are coming on at an easy pace, besides completely checking the course of their own attack and exposing themselves in masses to the enemy's fire.

A moderate loss sustained by attacking cavalry when 300 or 400 yards off would considerably reduce their ardour, and if their charge was pushed home, what chance could scattered, or even small bodies of horsemen have, against any tolerably strong line of skirmishers who had been trained to rely on themselves and their weapons, and who were taking advantage of every undulation, ditch, or rock, our own cavalry and artillery most probably not being at the same time inactive?

We have to bring up our infantry in that formation least likely to sustain loss, but yet in sufficient force to make, with immediate reinforcements, the final rush on certain points, and yet be ready to meet any unexpected counter-attack.

Now supposing, for argument sake, that the enemy, strongly posted, had to be attacked straight in front, but that they could not move a man from their position to make a counter-attack, but were merely to keep up a very heavy fire on our advance; would any advocate of our old line formation move our men up in line or any other arrangement, such as rushing double-companies two deep, across a space swept by a hot fire? I seriously doubt it. The matter, therefore, resolves itself into this: that the line-formation is continued, despite the inevitable loss it must sustain, because the men being in greater confidence

when together, a counter-attack by an enemy is less likely to succeed. This, however, I demur to, for great loss means great confusion.

But suppose we *train* our men to act with deliberation when in skirmishing formation—that we *teach* them that the enemy's cavalry, which, being the most rapid, is the most likely force to make a counter-attack to stop our advance, can be beaten off without delaying it; we can surely rest satisfied that a loose formation which enables us in the first instance to approach an enemy's position and to reinforce for the final rush, one might almost say at our leisure, such points of our line of attack which afford most cover, is preferable to any two-deep line.

I cannot, therefore, avoid coming to the conclusion that, sooner or later, the fighting formation of our infantry, whether against Europeans or natives (for to save loss is a point gained against either), must be the loose line of skirmishers capable of being rapidly strengthened, whenever practicable, by supports well *in* hand and *at* hand; that that line must emphatically hold its own wherever it may have reached; and that all movements of troops in rear of it, must be considered as only accessory to its reinforcement and urging forward.

The successive reinforcement of the head of each company's attack on a comparatively narrow front by its successive sections, according to my plan, meets fairly, I think, this desideratum; for it gives the Captains more tactical opportunity, enables them to seize immediately on favourable ground and to occupy it very strongly by reinforcing, on their own responsibility, directly available cover justifies their so doing; and, above all, keeps their men under their own guidance, unmixed with those of other companies. According to our present system, a Captain has to make an attempt at directing his company, extended over about 250 paces of front, and has to look for reinforcement to another company, which being *all together* in rear of *one part* of the line, may most probably be too far from those points most requiring *immediate* reinforcement: but directly it does come up, there will ensue intermixture, confusion, and divided command and responsibility.

Note.—I would further suggest that a brigade of infantry thrown into this formation could dispense with the necessity of having any battalions in second line—the reserve half-battalions being in effect in second line to their leading half-battalions—a great advantage.